2021

Groundwater Management Plan

for the Santa Clara and Llagas Subbasins

Valley Water

Santa Clara Valley Water District

2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Prepared by:

Jason Gurdak, Ph.D., P.H.
Senior Water Resources Specialist

George Cook, P.G.
Senior Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.
Groundwater Management Unit Manager

Greg Williams
Deputy Operating Officer
Raw Water Division

Aaron Baker, P.E.
Chief Operating Officer
Water Utility Enterprise

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Contributors:

Chanie Abuye
Randy Behrens
Michael Bunij
Keila Cisneros
Scott Elkins
Ardy Ghoreishi
Simon Gutierrez
Jeannine Larabee
Yaping Liu
Travis Moore
Roger Pierno
Colton Short
Xiaoyong Zhan

Graphic Design:

Benjamin Apolo III
Aster Hung
Jimin Lee
Joy Lim
Michelle Wong

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Richard P. Santos
District 3

Nai Hsueh
District 5

TABLE OF CONTENTS

Page Number

EXECUTIVE SUMMARY **ES-1**

CHAPTER 1 – INTRODUCTION **1-1**

1.1 GROUNDWATER MANAGEMENT PLAN 2021 OVERVIEW 1-1

1.1.1 Assessment of Plan Implementation 1-1
1.1.2 Contact Information 1-2

1.2 DESCRIPTION OF PLAN AREA 1-2

1.3 BASELINE AND PLANNING HORIZON 1-4

1.4 VALLEY WATER OVERVIEW 1-5

1.4.1 Valley Water History 1-9
1.4.2 Valley Water Authority 1-13
1.4.2.1 Authorities Provided by the District Act 1-14
1.4.2.2 Authorities Provided by SGMA 1-14
1.4.3 Valley Water Management Structure 1-18
1.4.4 Water Utility Enterprise Financial Overview 1-18
1.4.5 Relation to Other Valley Water Programs and Plans 1-18

1.5 GROUNDWATER MANAGEMENT PARTNERS AND STAKEHOLDERS 1-19

1.5.1 Water Retailers 1-19
1.5.2 Land Use Agencies 1-20
1.5.3 Local, State, and Federal Agencies 1-20
1.5.4 Other Stakeholders 1-22

1.6 PUBLIC OUTREACH FOR THE 2021 GROUNDWATER MANAGEMENT PLAN 1-22

1.7 PLAN CONTENT AND ORGANIZATION 1-23

CHAPTER 2 – SANTA CLARA SUBBASIN DESCRIPTION **2-1**

2.1 BASIN SETTING 2-1

2.1.1 Lateral Subbasin Boundaries 2-2
2.1.2 Recharge Areas 2-2
2.1.3 Principal Aquifers and Aquitards 2-2
2.1.4 Subbasin Bottom 2-8
2.1.5 Major Faults 2-9

2.2 SUBBASIN CONDITIONS 2-10

2.2.1 Groundwater Elevation and Flow 2-10
2.2.2 Land Subsidence 2-14
2.2.3 Surface Water and Groundwater Interaction 2-18
2.2.4 Groundwater Dependent Ecosystems 2-23
2.2.5 Groundwater Quality 2-25
2.2.5.1 Santa Clara Plain 2-25
2.2.5.2 Coyote Valley 2-35
2.2.6 Seawater Intrusion 2-39

TABLE OF CONTENTS

Page Number

CHAPTER 3 – LLAGAS SUBBASIN DESCRIPTION **3-1**

3.1 BASIN SETTING 3-1

3.1.1 Lateral Subbasin Boundaries 3-2
3.1.2 Recharge Areas 3-2
3.1.3 Principal Aquifers and Aquitards 3-2
3.1.4 Subbasin Bottom 3-8
3.1.5 Major Faults 3-8

3.2 SUBBASIN CONDITIONS 3-9
3.2.1 Groundwater Elevation and Flow 3-9
3.2.2 Land Subsidence 3-12
3.2.3 Surface Water and Groundwater Interaction 3-12
3.2.4 Groundwater Dependent Ecosystems 3-15
3.2.5 Groundwater Quality 3-17
3.2.6 Seawater Intrusion 3-26

CHAPTER 4 – WATER SUPPLIES, DEMANDS AND BUDGET **4-1**

4.1 COUNTYWIDE WATER SUPPLY SOURCES 4-1

4.1.1 Local Surface Water 4-1
4.1.2 Groundwater 4-2
4.1.3 Imported Water 4-2
4.1.4 Recycled and Purified Water 4-2

4.2 WATER USE 4-3

4.3 CONJUNCTIVE WATER MANAGEMENT 4-3

4.3.1 Managed Recharge 4-4
4.3.2 In-Lieu Recharge 4-6

4.4 GROUNDWATER BUDGET 4-8

4.4.1 Santa Clara Subbasin 4-8
4.4.1.1 Groundwater Pumping 4-9
4.4.1.2 Groundwater Recharge 4-11
4.4.1.3 Groundwater Storage 4-12
4.4.1.4 Water Budget 4-14
4.4.2 Llagas Subbasin 4-15
4.4.2.1 Groundwater Pumping 4-15
4.4.2.2 Groundwater Recharge 4-17
4.4.2.3 Groundwater Storage 4-17
4.4.2.4 Water Budget 4-18

4.5 FUTURE DEMANDS 4-19

4.6 CLIMATE CHANGE IMPACTS ON GROUNDWATER BUDGET 4-21

TABLE OF CONTENTS

Page Number

CHAPTER 5 – SUSTAINABLE MANAGEMENT CRITERIA **5-1**

5.1 SUSTAINABLE MANAGEMENT CRITERIA 5-1

5.2 SUSTAINABILITY GOALS 5-2

5.2.1 Groundwater Supply Reliability 5-2
5.2.2 Groundwater Quality Protection 5-3

5.3 BASIN MANAGEMENT STRATEGIES 5-3

5.4 OUTCOME MEASURES 5-6

5.4.1 Groundwater Storage 5-6
5.4.2 Groundwater Levels and Land Subsidence 5-7
5.4.3 Water Quality 5-9
5.4.4 Seawater Intrusion 5-11

CHAPTER 6 – BASIN MANAGEMENT PROGRAMS AND ACTIVITIES **6-1**

6.1 PROGRAMS TO MAINTAIN A RELIABLE GROUNDWATER SUPPLY 6-1

6.1.1 Managed Recharge 6-1
6.1.1.1 Reservoirs and Diversions 6-2
6.1.1.2 In-Stream Managed Recharge 6-3
6.1.1.3 Off-Stream Managed Recharge 6-3
6.1.1.4 Indirect Potable Reuse 6-3
6.1.1.5 Treated Groundwater Reinjection Program 6-4
6.1.1.6 Injection Well Pilot 6-4
6.1.2 In-Lieu Recharge 6-4
6.1.2.1 Treated Water Operations 6-4
6.1.2.2 Groundwater Banking and Supplemental Water Supplies 6-5
6.1.2.3 Water Conservation 6-5
6.1.2.4 Water Recycling 6-6
6.1.3 Protection of Natural Recharge 6-6
6.1.4 Groundwater Production Management 6-6
6.1.4.1 Groundwater Production Measurement 6-6
6.1.4.2 Retailer Coordination on Source Shifts and Shortage Response 6-7
6.1.4.3 Groundwater Zones and Groundwater Charges 6-8
6.1.4.4 Pricing Policies 6-11
6.1.5 Water Accounting 6-11
6.1.6 Groundwater Level and Storage Assessment 6-11
6.1.6.1 Operations Planning to Meet Near-Term Needs 6-12
6.1.6.2 Contingency Planning 6-12
6.1.6.3 Planning to Meet Future Needs 6-13
6.1.7 Asset Management 6-13

6.2 PROGRAMS TO PROTECT GROUNDWATER QUALITY 6-14

6.2.1 Well Ordinance Program 6-14
6.2.2 Domestic Well Testing Program 6-14
6.2.3 Recycled Water Irrigation Evaluation 6-15

TABLE OF CONTENTS

Page Number

6.2.4 Vulnerability Assessment 6-16
6.2.4.1 Groundwater Vulnerability Studies 6-16
6.2.4.2 Drinking Water Source Assessment and Protection Program (DWSAP) 6-16
6.2.5 Coordination with Land Use Agencies 6-17
6.2.5.1 Land Use Review 6-17
6.2.5.2 Onsite Wastewater Treatment Systems (Septic Systems) 6-17
6.2.6 Coordination with Regulatory Agencies 6-18
6.2.6.1 Hazardous Material Handling and Storage Oversight 6-18
6.2.6.2 Contaminant Release Sites 6-18
6.2.7 Public Outreach 6-20
6.2.7.1 Outreach Materials 6-20
6.2.7.2 School Program 6-21
6.2.7.3 Groundwater Guardian Program 6-21

6.3 PROGRAMS RELATED TO SURFACE WATER/GROUNDWATER INTERACTION 6-21

6.3.1 In-Stream Releases of Surface Water 6-21
6.3.2 Stormwater Management 6-21
6.3.3 Seawater Intrusion Prevention 6-22
6.3.4 Watershed Management 6-23

6.4 OTHER PROJECTS AND ACTIVITIES TO SUPPORT CONTINUED SUSTAINABILITY 6-24

CHAPTER 7 – GROUNDWATER MONITORING AND MODELING 7-1

7.1 GROUNDWATER LEVEL MONITORING 7-1

7.1.1 Groundwater Monitoring Network and Measurement Frequency 7-1
7.1.2 Measurement Methodology 7-3
7.1.2.1 Ground Surface and Measuring Point Elevation Measurement 7-3
7.1.2.2 Manual Depth to Water Measurement 7-4
7.1.2.3 Automated Depth to Water Measurement 7-5
7.1.2.4 Water Level Instrument Calibration 7-5
7.1.3 Data Management 7-5
7.1.4 Reporting and Communication 7-6

7.2 LAND SUBSIDENCE MONITORING 7-6

7.2.1 Annual Benchmark Elevation Surveys 7-7
7.2.2 Extensometer Monitoring 7-7

7.3 GROUNDWATER QUALITY MONITORING 7-8

7.3.1 Regional Groundwater Quality Monitoring 7-9
7.3.1.1 Valley Water Regional Groundwater Quality Monitoring Network and Frequency 7-9
7.3.1.2 Monitoring Parameters 7-14
7.3.2 Public Water Supplier Monitoring 7-16
7.3.3 Domestic Well Testing Program 7-17
7.3.4 Monitoring Near Recycled Water Irrigation Sites 7-17
7.3.4.1 Valley Water Recycled Water Irrigation Site Monitoring Network and Frequency 7-19
7.3.4.2 Valley Water Monitoring Parameters 7-20

TABLE OF CONTENTS

Page Number

7.3.4.3 Other Monitoring Near Recycled Water Irrigation Sites 7-22
7.3.5 Groundwater Quality Monitoring Programs by Other Agencies 7-22
7.3.5.1 GAMA 7-22
7.3.5.2 Irrigated Lands Program 7-23
7.3.6 Valley Water Groundwater Quality Monitoring Protocols 7-23
7.3.6.1 Valley Water Groundwater Quality Sampling Methodology 7-24
7.3.6.2 Laboratory Analysis and Data Validation 7-25
7.3.6.3 Data Management 7-26

7.4 SURFACE WATER MONITORING 7-26

7.4.1 Valley Water Recharge Water Quality Monitoring 7-26
7.4.1.1 Monitoring Locations and Frequency 7-26
7.4.1.2 Monitoring Parameters 7-26
7.4.1.3 Monitoring Protocols 7-30
7.4.1.4 Recharge Water Quality Data Management 7-30
7.4.1.5 Recharge Reporting and Communication 7-30
7.4.2 Surface Water Flow Monitoring 7-30
7.4.3 Surface Water Quality Monitoring by Other Agencies 7-32
7.4.3.1 Central Coast Ambient Monitoring Program 7-32
7.4.3.2 Santa Clara Valley Urban Runoff Pollution Prevention Program 7-33

7.5 REPORTING AND DATA AVAILABILITY 7-33

7.6 GROUNDWATER MODELS 7-35

7.6.1 Santa Clara Subbasin Models 7-35
7.6.1.1 Santa Clara Plain Model 7-36
7.6.1.2 Coyote Valley Model 7-36
7.6.2 Llagas Subbasin Model 7-37
7.6.3 Groundwater Storage Analysis 7-38

CHAPTER 8 – NEXT STEPS 8-1

8.1 EVALUATION AND REPORTING OF OUTCOME MEASURES 8-1

8.2 ADDRESSING OUTCOME MEASURE PERFORMANCE 8-1

8.2.1 Groundwater Supply Reliability 8-1
8.2.2 Groundwater Quality Protection 8-2

8.3 GROUNDWATER MANAGEMENT PLAN RECOMMENDATIONS 8-3

LIST OF FIGURES

Page Number

Figure ES-1. Santa Clara County Groundwater History ES-4
Figure ES-2. Santa Clara County Groundwater Subbasins ES-5

Figure 1-1. Santa Clara and Llagas Subbasins 1-3
Figure 1-2 Topography of the Santa Clara and Llagas Subbasins 1-4
Figure 1-3. Santa Clara County Groundwater History 1-6
Figure 1-4. Valley Water's Water Supply Treatment and Distribution System 1-8
Figure 1-5. North County Water Supply and Use (2010 to 2019) 1-9
Figure 1-6. South County Water Supply and Use (2010 to 2019) 1-9
Figure 1-7. Valley Water Evolution 1-11
Figure 1-8. Overview of Groundwater Management Roles 1-21

Figure 2-1. Santa Clara Subbasin 2-1
Figure 2-2. Quaternary Alluvium Geologic Map of the Santa Clara Subbasin 2-4
Figure 2-3. Santa Clara Subbasin Cross-Section Locations 2-5
Figure 2-4. Santa Clara Subbasin Longitudinal Cross-Section 2-6
Figure 2-5. Santa Clara Subbasin Transverse Cross-Section 2-7
Figure 2-6. Santa Clara Plain Bedrock Surface 2-8
Figure 2-7. Location of Major Fault Systems 2-9
Figure 2-8. Spring 2019 Principal Aquifer Groundwater Elevation Contours 2-11
Figure 2-9. Fall 2019 Principal Aquifer Groundwater Elevation Contours 2-12
Figure 2-10. Groundwater Elevation in the Santa Clara Plain Regional Index Well (07S01W25L001) 2-13
Figure 2-11. Groundwater Elevation in the Coyote Valley Regional Index Well (09S02E02J002) 2-13
Figure 2-12. Historical Subsidence in the Santa Clara Plain (1934 to 1967) 2-15
Figure 2-13. Historical and Potential Subsidence in the Santa Clara Plain 2-16
Figure 2-14. Vertical Ground Surface Displacement in the Santa Clara Plain from InSAR Data (2015 to 2019) 2-17
Figure 2-15. Santa Clara Subbasin Surface Water/Groundwater Interaction 2-19
Figure 2-16. Santa Clara Subbasin Historical Ecology 2-21
Figure 2-17. Depth to First Groundwater in the Santa Clara Subbasin 2-22
Figure 2-18. Groundwater Dependent Ecosystems in the Santa Clara Subbasin 2-24
Figure 2-19. Santa Clara Plain Principal Aquifer Water Quality Overview (2010–2019) 2-27
Figure 2-20. Santa Clara Subbasin Principal Aquifer Concentrations Relative to Primary Drinking Water Standards (2010–2019) 2-28
Figure 2-21. Santa Clara Subbasin Principal Aquifer Concentrations Relative to Secondary Drinking Water Standards (2010–2019) 2-29
Figure 2-22. Coyote Valley Principal Aquifer Water Quality Overview (2010–2019) 2-36
Figure 2-23. Conceptual Diagram of Seawater Intrusion (SWI) in the Santa Clara Subbasin by the Mechanism of Leakance of Saltwater Beneath Tidal Streamflow 2-40
Figure 2-24. Extent of Seawater Intrusion in the Santa Clara Plain Shallow Aquifer Zone 2-41
Figure 2-25. Classic Seawater Intrusion Beneath the South San Francisco Bay and Former Salt Ponds 2-42
Figure 2-26. Sea-Level Rise Effects on Seawater Intrusion Beneath the South San Francisco Bay and Former Salt Ponds 2-43

Figure 3-1. Llagas Subbasin 3-1
Figure 3-2. Quaternary Alluvium Geologic Map of the Llagas Subbasin 3-3

LIST OF FIGURES

Page Number

Figure 3-3.	Llagas Subbasin Cross-Section Locations	3-4
Figure 3-4.	Llagas Subbasin Longitudinal Cross-Section	3-5
Figure 3-5.	Llagas Subbasin Northern Transverse Cross-Section	3-6
Figure 3-6.	Llagas Subbasin Southern Transverse Cross-Section	3-7
Figure 3-7.	Major Faults	3-8
Figure 3-8.	Groundwater Elevation in the Llagas Subbasin Regional Index Well (10S03E01N005)	3-9
Figure 3-9.	Spring 2019 Principal Aquifer Groundwater Elevation Contours	3-10
Figure 3-10.	Fall 2019 Principal Aquifer Groundwater Elevation Contours	3-11
Figure 3-11.	Llagas Subbasin Historical Ecology	3-13
Figure 3-12.	Depth to First Groundwater in the Llagas Subbasin	3-14
Figure 3-13.	Groundwater Dependent Ecosystems in the Llagas Subbasin	3-16
Figure 3-14.	Llagas Subbasin Principal Aquifer Water Quality Overview (2010–2019)	3-19
Figure 3-15.	Llagas Subbasin Principal Aquifer Concentrations Relative to Primary Drinking Water Standards (2010–2019)	3-20
Figure 3-16.	Llagas Subbasin Principal Aquifer Concentrations Relative to Secondary Drinking Water Standards (2010–2019)	3-21
Figure 4-1.	Countywide Water Use by Source (2010–2019)	4-3
Figure 4-2.	Managed Recharge Facilities in the Santa Clara Subbasin	4-4
Figure 4-3.	Managed Recharge Facilities in the Llagas Subbasin	4-5
Figure 4-4.	Countywide Groundwater Pumping and Managed Recharge	4-6
Figure 4-5.	Santa Clara County Supplies and Water Use	4-7
Figure 4-6.	Groundwater Budget for the Santa Clara and Llagas Subbasins (2010–2019)	4-8
Figure 4-7.	Santa Clara Plain Groundwater Pumping by Use	4-9
Figure 4-8.	Coyote Valley Groundwater Pumping by Use	4-9
Figure 4-9.	Santa Clara Subbasin Pumping Distribution (2019)	4-10
Figure 4-10.	Annual Change in Storage in the Santa Clara Plain (1970–2019)	4-13
Figure 4-11.	Annual Change in Storage in the Coyote Valley (1987–2019)	4-13
Figure 4-12.	Llagas Subbasin Groundwater Pumping by Use	4-16
Figure 4-13.	Llagas Subbasin Pumping Distribution (2019)	4-16
Figure 4-14.	Annual Change in Storage in the Llagas Subbasin (1987–2019)	4-18
Figure 5-1.	Valley Water Policy Framework	5-1
Figure 5-2.	Relation Between Valley Water Policy and 2021 GWMP	5-2
Figure 5-3.	Historical 100 mg/L Chloride Isocontours in the Shallow Aquifer Zone of the Santa Clara Subbasin	5-12
Figure 5-4.	Seawater Intrusion Outcome Measure and Outcome Measure-Lower Threshold	5-13
Figure 6-1.	Modified Groundwater Benefit Zone W-2	6-9
Figure 6-2.	Modified Groundwater Benefit Zone W-5 and New Zones W-7 and W-8	6-10
Figure 6-3.	Contaminant Release Sites in the Santa Clara Subbasin	6-19
Figure 6-4.	Contaminant Release Sites in the Llagas Subbasin	6-20
Figure 7-1.	Santa Clara Subbasin Groundwater Level Monitoring Wells	7-2
Figure 7-2.	Llagas Subbasin Groundwater Level Monitoring Wells	7-3
Figure 7-3.	Valley Water Land Subsidence Monitoring in the Santa Clara Plain	7-7

LIST OF FIGURES

Page Number

Figure 7-4.	San Jose ("Martha") Extensometer	7-8
Figure 7-5.	Santa Clara Subbasin Shallow Aquifer Groundwater Quality Monitoring Network	7-11
Figure 7-6.	Santa Clara Subbasin Principal Aquifer Groundwater Quality Monitoring Network	7-12
Figure 7-7.	Llagas Subbasin Shallow Aquifer Groundwater Quality Monitoring Network	7-13
Figure 7-8.	Llagas Subbasin Principal Aquifer Groundwater Quality Monitoring Network	7-14
Figure 7-9.	Public Water Supplier Groundwater Quality Monitoring (2019)	7-16
Figure 7-10.	Valley Water Domestic Well Testing Locations (2019)	7-17
Figure 7-11.	Santa Clara Subbasin Groundwater Quality Monitoring Near Recycled Water Irrigation Sites	7-18
Figure 7-12.	Llagas Subbasin Groundwater Quality Monitoring Near Recycled Water Irrigation Sites	7-19
Figure 7-13.	Location of Valley Water Recharge Water Quality Sampling Locations in the Santa Clara Subbasin	7-27
Figure 7-14.	Location of Valley Water Recharge Water Quality Sampling Locations in the Llagas Subbasin	7-28
Figure 7-15.	Santa Clara Subbasin Stream Gauging Locations	7-31
Figure 7-16.	Llagas Subbasin Stream Gauging Locations	7-32
Figure 7-17.	Groundwater Flow Model Domain and Boundary Conditions	7-35

LIST OF TABLES

Page Number

Table ES-1.	Outcome Measures and Outcome Measure - Lower Thresholds	ES-7
Table 2-1.	Groundwater Dependent Ecosystems Area in the Santa Clara Subbasin	2-25
Table 2-2.	Santa Clara Plain Shallow Aquifer Zone Water Quality Summary (2010–2019)	2-30
Table 2-3.	Santa Clara Plain Principal Aquifer Zone Water Quality Summary (2010–2019)	2-32
Table 2-4.	Santa Clara Plain Shallow Aquifer Zone Organic Parameter Detections (2010–2019)	2-33
Table 2-5.	Santa Clara Plain Principal Aquifer Zone Organic Parameter Detections (2010–2019)	2-34
Table 2-6.	Coyote Valley Groundwater Quality Summary (2010–2019)	2-37
Table 2-7.	Summary of Organic Parameters Detected in the Coyote Valley (2010–2019)	2-38
Table 3-1.	Groundwater Dependent Ecosystems in the Llagas Subbasin	3-17
Table 3-2.	Llagas Subbasin Shallow Aquifer Zone Water Quality Summary (2010–2019)	3-22
Table 3-3.	Llagas Subbasin Principal Aquifer Zone Organic Parameter Detections (2010–2019)	3-24
Table 3-4.	Llagas Subbasin Shallow Aquifer Zone Organic Parameter Detections (2010–2019)	3-25
Table 3-5.	Llagas Subbasin Principal Aquifer Zone Organic Parameter Detections (2010–2019)	3-26
Table 4-1.	Santa Clara County Reservoir Capacities	4-1
Table 4-2.	Santa Clara Subbasin Managed Recharge Facility Summary	4-11
Table 4-3.	Santa Clara Plain Principal Aquifer Budget (2010–2019)	4-14
Table 4-4.	Coyote Valley Budget (2010–2019)	4-15
Table 4-5.	Llagas Subbasin Managed Recharge Facility Summary	4-17
Table 4-6.	Llagas Subbasin Principal Aquifer Budget (2010–2019)	4-19
Table 4-7.	Projected Countywide Demands (AF)	4-20
Table 4-8.	Global Climate Models (GCMs)	4-22
Table 4-9.	Projected Natural Recharge for the Santa Clara and Llagas Subbasins (Calendar Year 2045)	4-23
Table 4-10.	Projected Groundwater Budget for the Santa Clara and Llagas Subbasins (Calendar Year 2045)	4-24
Table 5-1.	Subsidence Thresholds	5-8
Table 6-1.	Valley Water Well Metering Summary (FY 2019)	6-7
Table 6-2.	Stages of Valley Water's Water Shorage Contingency Plan (WSCP)	6-12
Table 6-3.	Status of Contaminant Release Sites	6-18
Table 6-4.	Oversight of Contaminant Release Sites	6-19
Table 7-1.	Groundwater Level Monitoring Frequency	7-2
Table 7-2.	Manual Depth to Water Measurement Methods and Accuracy	7-4
Table 7-3.	Santa Clara Subbasin Regional Groundwater Quality Monitoring Summary	7-10
Table 7-4.	Llagas Subbasin Groundwater Quality Monitoring Summary	7-10
Table 7-5.	Valley Water Regional Groundwater Quality Monitoring Analytical Schedule	7-10
Table 7-6.	Valley Water Regional Groundwater Quality Monitoring Parameters and Analytical Methods	7-15
Table 7-7.	Valley Water Recycled Water Site Monitoring Parameters and Analytical Methods	7-21
Table 7-8.	Equipment Decontamination Levels	7-25
Table 7-9.	Recharge Water Quality Monitoring Schedule	7-29

LIST OF TABLES

Page Number

Table 7-10.	Recharge Water Quality Monitoring Parameters	7-29
Table 7-11.	Groundwater Reports	7-34

LIST OF APPENDICES

References
Glossary
Acronyms and Abbreviations
Appendix A – Board Action and Groundwater Management Plan Outreach
Appendix B – Demonstration of Functional Equivalency
Appendix C – Response to Department of Water Resources (DWR) Recommended Actions
Appendix D – Dry Supply Wells During Drought
Appendix E – 2019 Annual Groundwater Report
Appendix F – Board of Directors Resolution No. 18-04
Appendix G – Groundwater Dependent Ecosystems
Appendix H – Seawater Intrusion Outcome Measure
Appendix I – Valley Water Managed Recharge Facilities
Appendix J – Gap Analysis of Monitoring Networks
Appendix K – Monitoring Well Details

Executive Summary

EXECUTIVE SUMMARY

Nearly half of the water used in Santa Clara County (county) is pumped from the Santa Clara and Llagas subbasins, with some communities relying solely on groundwater. For over 90 years, the Santa Clara Valley Water District (Valley Water) has managed groundwater in the county per statutory authority provided by the Santa Clara Valley Water District Act (District Act).[1] Valley Water's comprehensive groundwater management programs and investments have resulted in sustainable groundwater conditions for many decades and will ensure groundwater resources are sustainable far into the future.

This 2021 Groundwater Management Plan (GWMP) describes Valley Water's comprehensive groundwater management framework, including existing and potential actions to achieve basin sustainability goals and ensure continued sustainable groundwater management. The GWMP covers the Santa Clara and Llagas subbasins, located entirely in Santa Clara County and identified by the Department of Water Resources (DWR) as Basins 2-9.02 and 3-3.01, respectively.

GROUNDWATER MANAGEMENT PLAN AUTHORITY

This 2021 GWMP is prepared pursuant to authority granted by the District Act and supersedes all previous Groundwater Management Plans. The 2021 GWMP also satisfies the objectives of the Sustainable Groundwater Management Act (SGMA).

SGMA was enacted by the state legislature in 2014 and subsequent Groundwater Sustainability Plan (GSP) Emergency Regulations have resulted in statewide requirements for basins designated as medium and high priority basins by DWR. In the basins designated by DWR as medium and high priority, local public agencies and Groundwater Sustainability Agencies (GSAs) are required to develop and implement GSPs or alternatives to GSPs (Alternative Plans). DWR has identified the Santa Clara and Llagas subbasins as high-priority basins and are not critically overdrafted basins.

SGMA lists Valley Water as one of 18 exclusive agencies with powers to comply with SGMA within its statutory boundary.[2] In May 2016, following a public hearing, the District Board of Directors (Board) adopted a resolution to become the GSA for the Santa Clara and Llagas subbasins.

Prior to the statutory deadline of January 1, 2017, Valley Water submitted the 2016 GWMP for both the Santa Clara and Llagas subbasins to DWR as an Alternative Plan. The 2016 GWMP updated technical information from Valley Water's 2012 GWMP with information functionally equivalent to elements required by Articles 5 and 7 of the GSP Emergency Regulations. The 2016 GWMP met the requirements of California Water Code (Water Code) Section 10733.6, which allows for an Alternative Plan to be submitted to DWR. The 2016 GWMP, prepared pursuant to the District Act, qualified as an Alternative Plan per Water Code Section 10733.6(b)(1), which states that an Alternative Plan can be a plan developed pursuant to other law authorizing groundwater management. This 2021 GWMP is also prepared pursuant to the District Act.

VALLEY WATER OVERVIEW

Valley Water is an independent special district that provides wholesale water supply, groundwater management, flood protection, and stream stewardship for its service area, which includes all of Santa Clara County. The mission of Valley Water is to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. Valley

[1] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.
[2] California Water Code Section 10723 (a).

Executive Summary

Water is governed by an elected Board of Directors (Board), comprised of seven members elected from equally-divided districts drawn through a formal process.

Formed in 1929 in response to groundwater overdraft and subsidence, Valley Water has been a leader in the conjunctive management of groundwater and surface water for many decades. Under the District Act, Valley Water's objectives and authority related to groundwater management are to recharge groundwater basins, conserve, manage and store water for beneficial and useful purposes, increase water supply, protect surface water and groundwater from contamination, prevent waste or diminution of Valley Water's water supply, and do any and every lawful act necessary to ensure sufficient water is available for present and future beneficial uses.[3]

Groundwater management programs are funded by Valley Water's Water Utility Enterprise, with funding sources including charges for groundwater production, treated water, recycled water, and surface water, along with property taxes, interest earnings, reimbursements, and grants. These funds are used to operate and maintain Valley Water's complex water supply infrastructure network, maintain water supply sources and water rights, and make capital improvements as needed to ensure water supply reliability.

WATER SUPPLY AND GROUNDWATER OVERVIEW

Valley Water manages a diverse water supply portfolio, with sources including groundwater, local surface water, imported water, and recycled water. About half of the county's water supply comes from local sources and the other half comes from imported sources. Imported water includes Valley Water's State Water Project and Central Valley Project contract supplies, and supplies delivered by the San Francisco Public Utilities Commission (SFPUC) to cities in northern Santa Clara County. Local sources include natural groundwater recharge and surface water supplies. A small, but growing portion of the county's water supply is recycled water. Water conservation is also an important part of the water supply mix, which helps reduce water demands and improve reliability during droughts.

Valley Water does not supply groundwater directly to customers but sustainably manages the Santa Clara and Llagas subbasins to support beneficial use by water retailers, private well users, and the environment.[4] Valley Water supplies are distributed to recharge facilities in the Santa Clara and Llagas subbasins, drinking water treatment plants, local creeks for environmental needs, or directly to water users. The conjunctive management of surface water and groundwater maximizes water supply reliability, allowing Valley Water to store surface water in local groundwater basins to help balance pumping and provide reserves for use during dry years when surface water availability is limited.

Local groundwater resources make up the foundation of the county's water supply, but they need to be augmented by Valley Water's comprehensive water supply management activities to reliably meet the county's needs. These include the managed recharge of imported and local surface water and in-lieu recharge through the provision of treated surface water, acquisition of supplemental water supplies, and water conservation and recycling.

Valley Water also has programs to protect, manage, and sustain water resources. Valley Water operates and maintains a complex infrastructure network, with major features including:

- 10 surface water reservoirs
- 166,000 acre-feet total reservoir storage capacity
- 17 miles of raw surface water canals

[3] District Act, Sections 4 and 5.

[4] Valley Water has limited pumping capacity from three emergency backup wells, which have not been used to deliver water to customers but could be if needed.

- 102 groundwater recharge ponds covering 277 acres
- 91 miles of controlled in-stream recharge
- 142 miles of pipelines
- three pumping stations
- three drinking water treatment plants
- Silicon Valley Advanced Water Purification Center
- 184 Valley Water owned groundwater monitoring wells

In addition to working to secure adequate water supplies for the county, Valley Water also has a long history of protecting groundwater resources, beginning with efforts to address seawater intrusion adjacent to San Francisco Bay in the late 1950s.[5] In the 1980s, contamination from leaking chemical storage tanks at semiconductor manufacturing facilities brought groundwater quality issues to the forefront. Valley Water efforts to aggressively protect groundwater quality have included close coordination with regulatory agencies overseeing cleanup, the implementation of numerous programs including well construction/destruction regulations and efforts to reduce nitrate loading, the oversight of fuel leak cases, and efforts to influence statewide policy from threats such as MTBE, an additive formerly used in gasoline.[6] More recently, Valley Water has engaged with stakeholders to develop Salt and Nutrient Management Plans and to proactively evaluate threats posed by contaminants such as Per- and Polyfluoroalkyl Substances (PFAS). Valley Water continues to work with regulatory agencies and local water retailers to better understand the potential contaminants in local groundwater and take action if needed to ensure a safe and reliable drinking water supply.

Protecting groundwater resources is a key part of Valley Water's mission as demonstrated by the following Board policy related to water supply:

- Water Supply Objective 2.1.1: Manage groundwater to ensure sustainable supplies and avoid land subsidence.
- Water Supply Objective 2.1.2: Aggressively protect groundwater from the threat of contamination.

Figure ES-1 shows how Valley Water's investments and conjunctive management programs have contributed to a sustainable groundwater supply.

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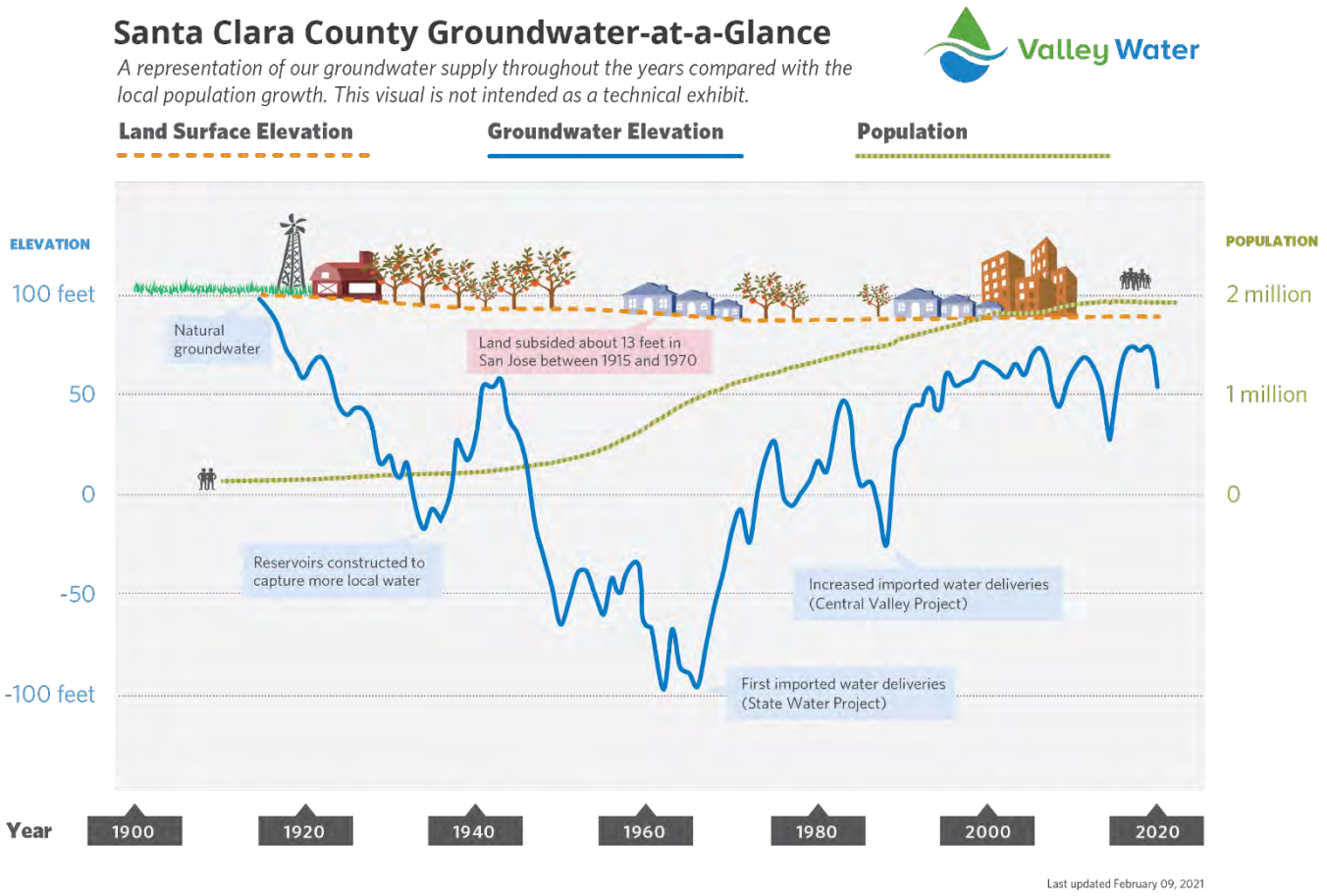
[5] Santa Clara Valley Water District, Saltwater Intrusion Investigation, September 1980.
[6] California History Center & Foundation, Water in the Santa Clara Valley: A History, 2005.

Figure ES-1. Santa Clara County Groundwater History



GROUNDWATER SUBBASINS

The 2021 GWMP covers the Santa Clara and Llagas subbasins, located entirely in Santa Clara County[7] and identified by DWR as Basins 2-9.02 and 3-3.01, respectively (Figure ES-2).[8] The Santa Clara Subbasin is part of the Santa Clara Valley Basin (Basin 2-9), which extends from southern San Jose north into Alameda, Contra Costa, and San Mateo counties. The Llagas Subbasin is part of the Gilroy-Hollister Valley Basin (Basin 3-3), which extends from Morgan Hill into San Benito County. The Santa Clara and Llagas subbasins cover a surface area of approximately 385 square miles (Figure ES-2). Due to different land use and management characteristics, Valley Water further delineates the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley. The Santa Clara and Llagas subbasins, which support average pumping of about 129,000 acre-feet (AF) a year, are described in detail in Chapters 2 and 3 of this GWMP.

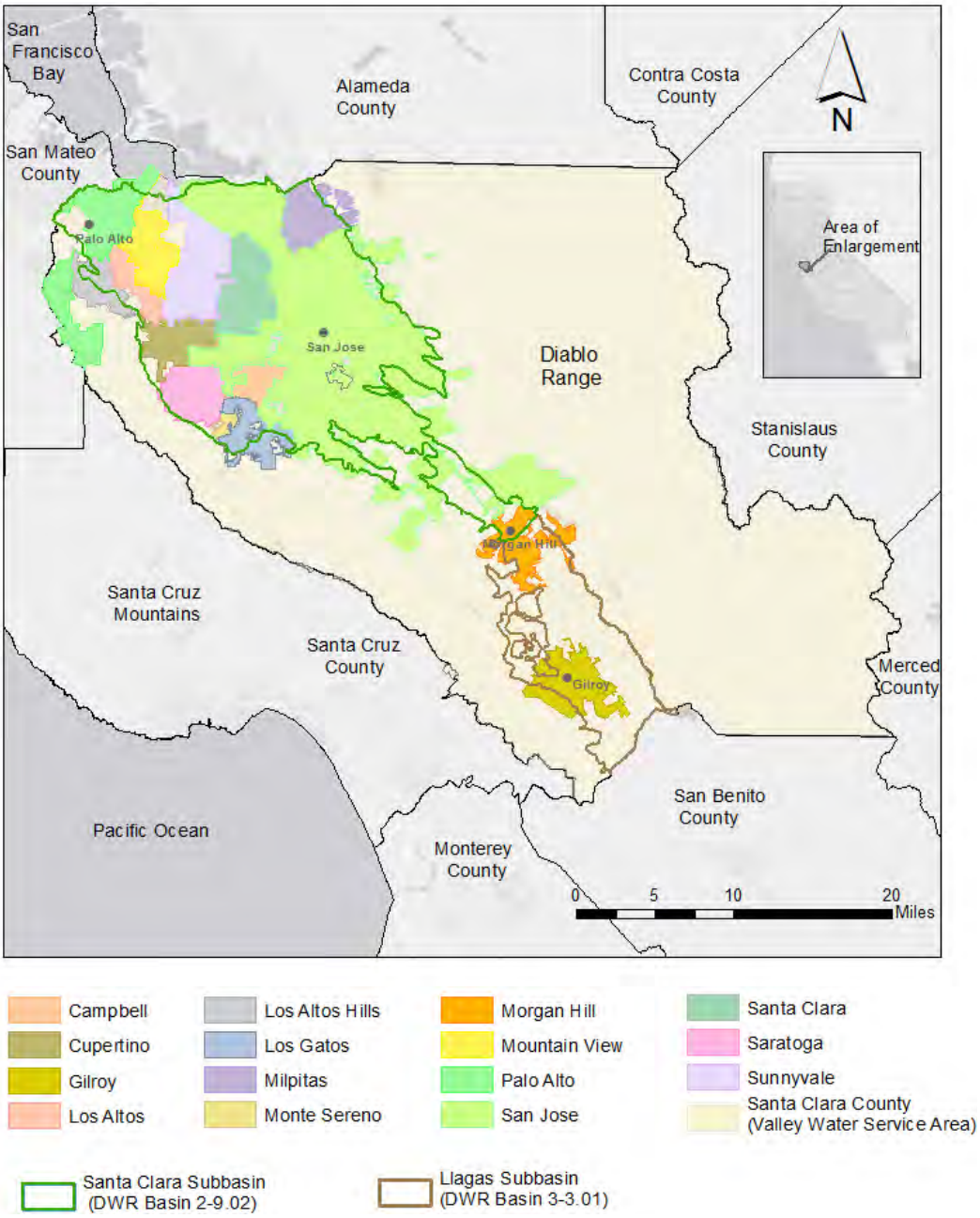
The groundwater subbasins provide multiple benefits to residents and businesses in Santa Clara County. Although most of the groundwater pumped originates from Valley Water's managed recharge program, the subbasins provide

[7] Valley Water is the GSA for a small portion of the medium-priority North San Benito Subbasin in southern Santa Clara County. A separate Groundwater Sustainability Plan (GSP) has been prepared for the North San Benito Subbasin, and this subbasin is not addressed in this 2021 GWMP.

[8] California Department of Water Resources, California's Groundwater: Bulletin 118 Update 2003.

some groundwater supply from the infiltration of rainfall in the recharge areas and natural seepage through local creeks and streams. In addition, the groundwater subbasins serve as an extensive conveyance network, allowing water to move from the recharge areas to individual groundwater wells. The groundwater subbasins also provide some natural filtration of surface water as it percolates through the soil and rock. The groundwater subbasins provide water storage, allowing water to be carried over from the wet season to the dry season and from wet years to dry years. Due to Valley Water's comprehensive groundwater management activities, the subbasins are in long-term balance. Groundwater quality is typically very good, and most public water supply wells do not require any treatment beyond disinfection.

Figure ES-2. Santa Clara County Groundwater Subbasins



Executive Summary

2021 GROUNDWATER MANAGEMENT PLAN

Valley Water's Board-adopted 2016 GWMP described Valley Water's comprehensive groundwater management framework, including basin management objectives, strategies, groundwater management programs, and outcome measures. On July 17, 2019, DWR approved the 2016 GWMP as an Alternative Plan, finding it satisfies the objectives of SGMA. Additionally, DWR proposed recommended actions for Valley Water's consideration to enhance the Alternative Plan and facilitate DWR evaluation. The 2021 GWMP is the first required five-year update to the approved Alternative Plan.

The 2021 GWMP updates and expands on technical information in the 2016 GWMP and addresses related recommendations from DWR and basin stakeholders. Basin management goals, strategies, programs, and outcome measures in the 2021 GWMP (summarized below) are very similar to the 2016 plan, as they have been effective in ensuring sustainable conditions.

Valley Water will continue to review and update the GWMP as needed, but at least every five years. This will ensure compliance with SGMA requirements for Alternative Plans and provide current groundwater management information to support five-year updates of the Urban Water Management Plan (UWMP) as required by State law. The next five-year update to the Alternative Plan is due to DWR by January 1, 2027.

BASIN SUSTAINABILITY GOALS AND STRATEGIES

The following sustainability goals related to groundwater supply reliability and protection are based on Board policy:

- Manage groundwater to ensure sustainable supplies and avoid land subsidence.
- Aggressively protect groundwater from the threat of contamination.

These goals describe the overall objectives of Valley Water's groundwater management programs. The basin management strategies below are used to meet the sustainability goals. Many of these strategies (described in detail in Chapter 5) have overlapping benefits, acting to improve water supply reliability, minimize subsidence, and protect or improve groundwater quality.

1. Manage groundwater in conjunction with surface water.
2. Implement programs to protect and promote groundwater quality.
3. Maintain and develop adequate groundwater models and monitoring networks.
4. Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

BASIN MANAGEMENT PROGRAMS AND ACTIVITIES

Valley Water and local partners have implemented numerous programs to protect groundwater resources that support the sustainability goals and strategies. Valley Water's annual Protection and Augmentation of Water Supplies (PAWS) Report[9] presents detailed information on Valley Water activities to ensure sustainable groundwater supplies, as does Chapter 6 of this GWMP. Valley Water's Water Utility Enterprise operations and capital budget for fiscal year 2021-22, which supports these activities, is $580 million.

The assessment of groundwater conditions relies on timely, accurate, and representative data. Valley Water's comprehensive monitoring programs related to groundwater levels, land subsidence, groundwater quality, recharge

[9] Available at www.valleywater.org.

water quality, and surface water flow are described in detail in Chapter 7.

OUTCOME MEASURES

Valley Water has developed outcome measures and outcome measure – lower thresholds for each sustainability indicator in Table ES-1 to gauge performance in meeting the basin sustainability goals.

Table ES-1. Outcome Measures and Outcome Measure – Lower Thresholds

Sustainability Indicator	Outcome Measure	Outcome Measure – Lower Threshold
Groundwater Storage	Projected end of year groundwater storage is greater than 278,000 acre-feet (AF) in the Santa Clara Plain, 5,000 AF in the Coyote Valley, and 17,000 AF in the Llagas Subbasin.	Projected end of year countywide groundwater storage is greater than Stage 5 (150,000 AF) of the Water Shortage Contingency Plan.
Subsidence	Groundwater levels are above subsidence thresholds at the Santa Clara Subbasin subsidence index wells.	Groundwater levels are above the historical low water levels at the majority of the Santa Clara Subbasin subsidence index wells.
Groundwater Quality	For Santa Clara Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).	At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.
Groundwater Quality	For Llagas Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).	At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.
Seawater Intrusion	In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than the historical maximum extent area (57 square miles).	In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than 81 square miles, which represents a one-mile radial buffer of the historical maximum extent area.

The basis for these outcome measures and a description of how they will be evaluated is presented in Chapter 5. The outcome measures have been updated since the 2016 GWMP to address DWR's recommended actions, and lower thresholds have been developed to indicate conditions that represent undesirable results. The outcome measures will be assessed annually, with related results presented in Valley Water's Annual Groundwater Report. If evaluation of the outcome measures indicates poor performance toward meeting a basin sustainability goal, Valley Water will first evaluate potential changes to existing programs and activities prior to considering significant

groundwater management changes. Any significant policy or investment decisions would be developed and evaluated in consultation with local stakeholders, as Valley Water does in current planning and budgeting processes.

NEXT STEPS

Valley Water's proactive groundwater management activities have resulted in sustainable groundwater conditions in the Santa Clara and Llagas subbasins, and continued planning, investments, and coordination will be needed to address future water supply challenges. Groundwater demands are projected to increase in the future with projected growth in the county. Through its long-range planning, Valley Water continues to work with its water retailers and stakeholders to develop and evaluate various actions and investments needed to address projected future shortfalls during multi-year droughts. In 2019, Valley Water completed the Water Supply Master Plan 2040, which is continuously monitored and evaluated annually through the Monitoring and Assessment Program (MAP).

To maintain the long-term sustainability of groundwater resources, the following actions are recommended:

1. Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.
2. Continue to aggressively protect groundwater quality through Valley Water's programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.
3. Continue to incorporate groundwater sustainability in Valley Water's planning efforts.
4. Maintain adequate monitoring programs and modeling tools.
5. Continue and enhance groundwater management partnerships with water retailers and land use agencies.

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CHAPTER 1 – INTRODUCTION

For over 90 years, the Santa Clara Valley Water District (Valley Water) has managed groundwater in Santa Clara County (county) per statutory authority provided by the Santa Clara Valley Water District Act (District Act).[10] Valley Water's comprehensive groundwater management programs and investments have resulted in sustainable groundwater conditions for many decades. In May 2016, following a public hearing, the Valley Water Board of Directors (Board) adopted a resolution to become the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas subbasins (Appendix A). Valley Water is also the primary water wholesaler, flood manager, and stream steward for the county.

Nearly half of the water used in the county is pumped from groundwater, with some communities relying solely on groundwater. The purpose of this 2021 Groundwater Management Plan (GWMP) is to describe basin management objectives and strategies, programs and activities that support those objectives, and outcome measures to gauge performance. This chapter provides an overview of Valley Water and the GWMP. It also describes other partners in groundwater management and stakeholder participation in the GWMP.

1.1 GROUNDWATER MANAGEMENT PLAN 2021 OVERVIEW

The Sustainable Groundwater Management Act (SGMA) was enacted by the State legislature in 2014 and subsequent Groundwater Sustainability Plans (GSPs) Emergency Regulations resulted in statewide requirements for basins designated as medium- and high-priority basins by Department of Water Resources (DWR). In the basins designated by DWR as medium and high priority, local public agencies and Groundwater Sustainability Agencies (GSAs) are required to develop and implement GSPs or alternatives to GSPs (Alternative Plans). California Water Code (Water Code) Section 10733.6(b)(1) states that an Alternative Plan can be a plan developed pursuant to other law authorizing groundwater management. DWR identified the Santa Clara and Llagas subbasins as high-priority based on criteria that include overlying population, projected growth, number of wells, irrigation acreage, groundwater reliance, and groundwater impacts. Neither subbasin has been identified as being critically overdrafted.

Valley Water's prior, Board adopted 2016 GWMP documented Valley Water's comprehensive groundwater management framework, including authorities, goals, programs, and metrics to assess performance. Prior to the statutory deadline of January 1, 2017, Valley Water submitted the 2016 GWMP to DWR as an Alternative Plan for both the Santa Clara and Llagas subbasins. On July 17, 2019, DWR approved the 2016 GWMP as an Alternative Plan that satisfies the objectives of SGMA. Additionally, DWR proposed recommended actions for the consideration of Valley Water to enhance the Alternative Plan and facilitate evaluation by DWR.

1.1.1 Assessment of Plan Implementation

This 2021 GWMP is the first required five-year update to the approved Alternative Plan. The 2021 GWMP is prepared pursuant to the District Act and supersedes all previous Groundwater Management Plans.

The 2021 GWMP continues to meet the intent of SGMA and contains information and elements that are functionally equivalent to the elements of a GSP in accordance with Water Code Section 10733.6 (b)(1) and Article 9 of the Emergency GSP Regulations.[11] This 2021 GWMP also is functionally equivalent to requirements in Articles 5 and 7 of the Emergency GSP Regulations, as described in Appendix B.

Basin management goals, strategies, programs, and outcome measures in the 2021 GWMP are very similar to the 2016 plan, as they have been effective in ensuring sustainable conditions. Valley Water's 2016 GWMP

[10] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.
[11] California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2.

documented numeric outcome measures to assess performance in meeting basin sustainability goals. These outcome measures relate to groundwater storage, land subsidence, and water quality and are largely unchanged in this 2021 GWMP because they have been effective in avoiding undesirable results and prompting action when needed, as documented in Valley Water's Annual Groundwater Report and the 2017–2020 Water Year reports submitted to DWR.

Valley Water has successfully implemented the GWMP and maintained sustainable groundwater conditions during the previous five years, as defined by outcome measures described in Chapter 5. While the GWMP has been successfully implemented, Valley Water has updated the 2021 GWMP as part of an adaptive groundwater management approach. The 2021 GWMP updates and expands on technical information in the 2016 GWMP. These updates include revising all information in the plan to reflect the most recent ten-year period from 2010–2019. The 2021 GWMP also reflects recommendations from Valley Water staff and stakeholders, which were outlined in the 2016 GWMP (Chapter 8). Similarly, this 2021 GWMP outlines recommendations (Chapter 8) that Valley Water staff plans to address during the subsequent five-year period. The most substantial plan updates reflected in the 2021 GWMP were based DWR's recommended actions (Appendix C).

1.1.2 Contact Information

Valley Water's contact for groundwater management issues is:

Ms. Vanessa De La Piedra, P.E.
Groundwater Management Unit Manager
5750 Almaden Expressway
San José, CA 95118
Telephone: (408) 630-2788
E-mail: vdelapiedra@valleywater.org

1.2 DESCRIPTION OF PLAN AREA

The 2021 GWMP covers the Santa Clara and Llagas subbasins, located entirely in Santa Clara County and identified by DWR as Basins 2-9.02 and 3-3.01, respectively (Figure 1-1).[12] The Santa Clara Subbasin is part of the Santa Clara Valley Basin (Basin 2-9), which extends from southern San José north into Alameda, Contra Costa, and San Mateo counties. The Santa Clara Valley Basin is divided into four subbasins, including the Santa Clara Subbasin within Valley Water's service area. Due to different land use and management characteristics, Valley Water further delineates the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley. Coyote Valley is a unique landscape and resource of statewide significance, as recognized in California Assembly Bill No. 948 (AB-948). The Llagas Subbasin is part of the Gilroy-Hollister Valley Basin (Basin 3-3), which extends from Morgan Hill into San Benito County. The Gilroy-Hollister Valley Basin has four subbasins, including the Llagas Subbasin within Santa Clara County. The Santa Clara and Llagas subbasins are described in detail in Chapter 2 and 3, respectively.

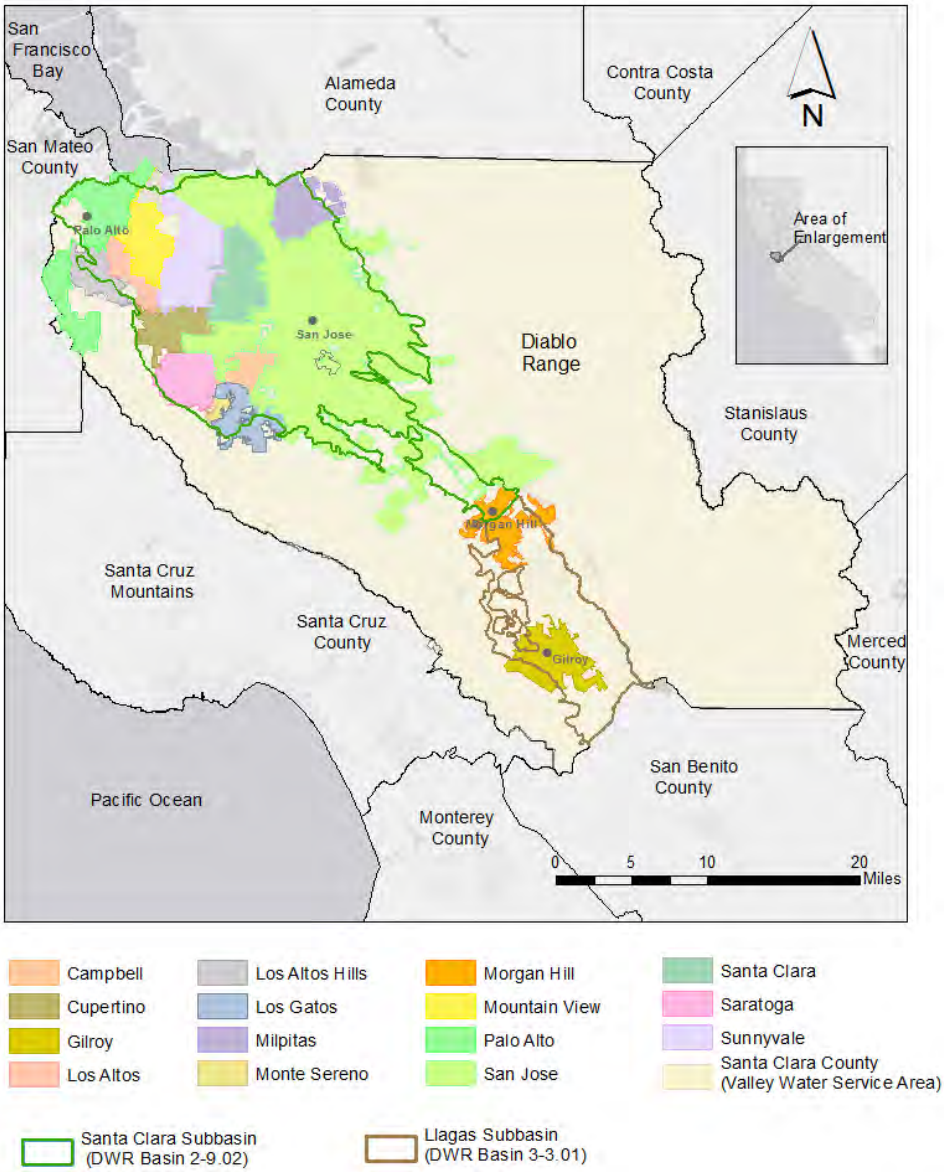
Santa Clara County is located at the southern end of the San Francisco Bay and encompasses approximately 1,300 square miles, making it the largest of the nine Bay Area counties. The county supports a population of nearly 2.0 million that is projected to increase to about 2.4 million by 2040[13]. Most water use occurs on the valley floor between the Santa Cruz Mountains to the west and the Diablo Range to the east. The footprint of the valley floor is essentially coincident with land overlying the Santa Clara and Llagas subbasins (Figure 1-2). Northern Santa Clara

[12] California Department of Water Resources, California's Groundwater: Bulletin 118 Interim Update 2016.
[13] Santa Clara Valley Water District, Water Supply Master Plan 2040

County (North County) is home to Silicon Valley and is highly urbanized. Southern Santa Clara County (South County) has urban development in the cities of Morgan Hill and Gilroy, but much of the land use is still rural and agricultural. North County generally coincides with land overlying the Santa Clara Plain, while South County generally represents land over the Coyote Valley and Llagas Subbasin.

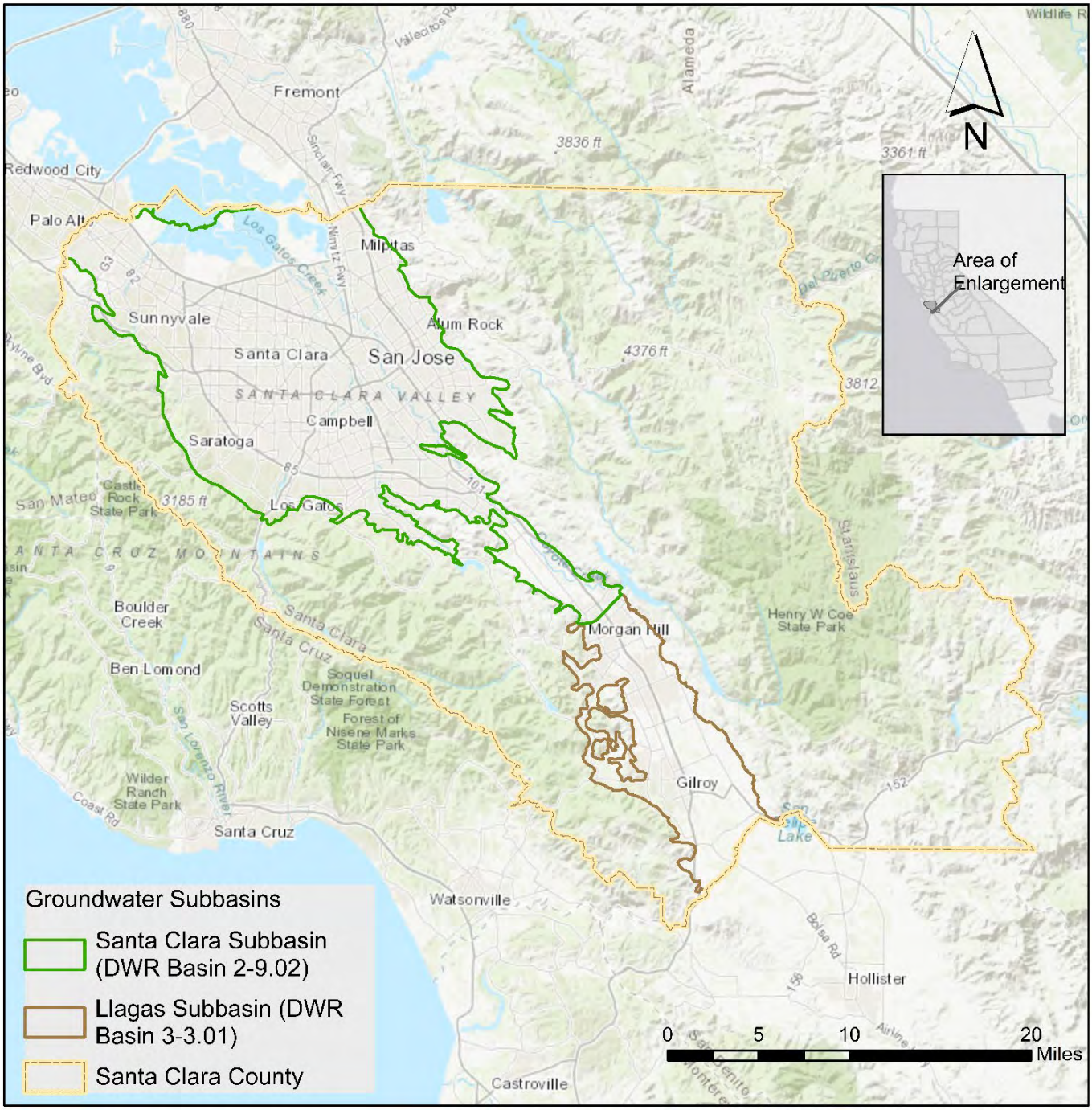
The county's Mediterranean semi-arid climate is temperate year-round, with warm and dry weather lasting from late spring through early fall. Average annual precipitation ranges from about 15 inches on the valley floor to about 45 inches along the crest of the Santa Cruz Mountains, with most precipitation occurring between the months of November and April. Maximum daily temperature averaged by month in Santa Clara County ranges from 55.6 to 83.4 degrees Fahrenheit, with average annual evapotranspiration of 49.6 inches.[14]

Figure 1-1. Santa Clara and Llagas Subbasins



[14] Santa Clara Valley Water District, 2020 Urban Water Management Plan.

Figure 1-2. Topography of the Santa Clara and Llagas Subbasins



1.3 BASELINE AND PLANNING HORIZON

The 2021 GWMP describes the Santa Clara and Llagas subbasins based on the most recent, representative water supply, demand, and water quality conditions. Information related to groundwater budgets is presented for the period 2010 through 2019, chosen to indicate longer-term (10 year) conditions including wet, normal, and dry years, and including prolonged drought conditions from 2012 to 2016. The most recent year 2019 is used to

display single-year groundwater supply information such as pumping distribution and groundwater elevation contours. Groundwater quality data, less affected by drought conditions, is also presented for the most recent data available for the ten-year period from 2010 to 2019. This approach uses a consistent range of time periods and best represents typical groundwater conditions in the Santa Clara and Llagas subbasins.

The plan also documents the effects of the 2012–2016 statewide drought through long-term hydrographs, annual change in groundwater storage charts, and other information. Prolonged drought resulted in lower groundwater levels and storage in the Santa Clara and Llagas subbasins, prompting the Board to call for water use reduction in 2014, 2015, and 2016 in accordance with Valley Water's Water Shortage Contingency Plan. Full recovery of groundwater levels and storage was observed by 2017 due to community water use reduction, retailer shifts to treated surface water, and increased managed recharge. Despite the drought, there were very limited impacts to well users, with fewer than 15 reports of wells going dry for domestic wells along the basin margins where well yield is more uncertain (Appendix D). Detailed information on more recent groundwater conditions is available in Valley Water's Annual Groundwater Reports prepared each calendar year. The 2019 Annual Groundwater Report is included in Appendix E. Valley Water has used the management approach outlined in the 2016 GWMP and lessons learned from the 2012–2016 drought to sustainably manage groundwater during the dry and drought conditions of 2020 and 2021.

Valley Water ensures reliable water supplies for all types of hydrologic years through annual operations planning and long-term planning studies like the Urban Water Management Plan (UWMP) and Water Supply Master Plan (WSMP). These long-term plans use over 90 years of measured or correlated local hydrologic data, are supported by information in the GWMP, have a 25-year planning horizon, and are updated every five years. This GWMP relies on the UWMP and WSMP for the evaluation of water supply projections, risks, and recommended investments to ensure continued water supply reliability. As such, it follows a similar planning horizon. Valley Water's adaptive operational decisions and proactive long-term water supply planning and investments will ensure continued, sustainable groundwater conditions long into the future.

1.4 VALLEY WATER OVERVIEW

Valley Water is an independent special district that provides wholesale water supply, groundwater management, flood protection, and stream stewardship for its service area, which includes all of Santa Clara County. The mission of Valley Water is to provide Silicon Valley safe, clean water for a healthy life, environment, and economy.

Valley Water was formed in 1929 in response to groundwater overdraft and subsidence. Valley Water has been a leader in conjunctive management for many decades, using imported and local surface water to replenish groundwater and maintain reliability in dry years. Figure 1-3 shows how Valley Water's investments and conjunctive management programs have contributed to a sustainable groundwater supply.

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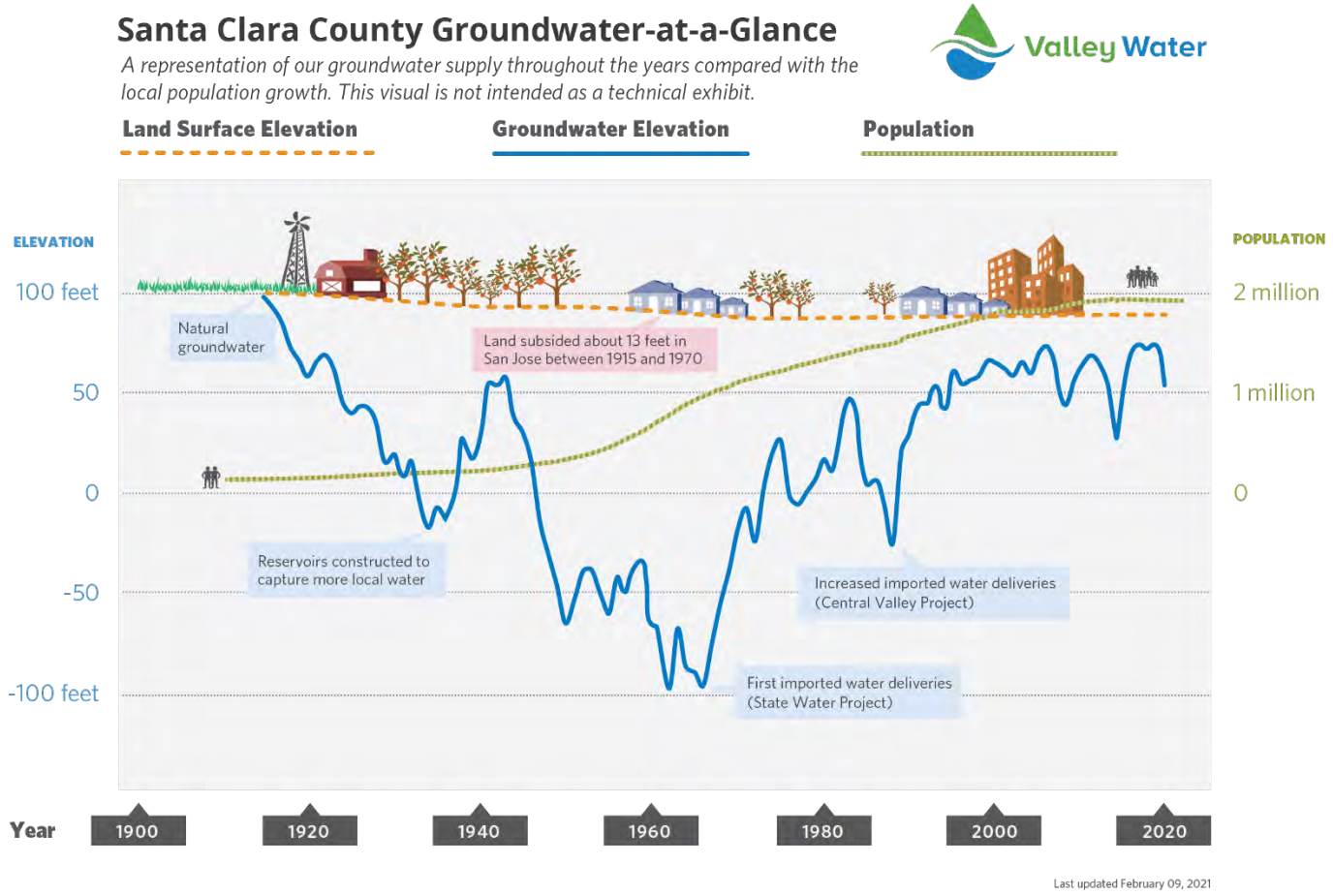
Figure 1-3. Santa Clara County Groundwater History



Valley Water manages a diverse water supply portfolio, with sources including groundwater, local surface water, imported water, and recycled water. About half of the county's water supply comes from local sources and about half comes from imported sources. Imported water includes Valley Water's State Water Project and Central Valley Project contract supplies, and supplies delivered by the San Francisco Public Utilities Commission (SFPUC) to cities in northern Santa Clara County. Local sources include natural groundwater recharge and surface water supplies, including surface water rights held by Valley Water, San Jose Water Company, and Stanford University. A small but growing portion of the county's water supply is recycled water. Long-term water conservation is also a key component of Valley Water's water supply management strategy. Conservation programs saved approximately 75,600 acre-feet (AF) in 2019 and are on target to reduce annual demands by nearly 109,000 AF by 2040[15].

Valley Water supplies are distributed to recharge facilities in the Santa Clara and Llagas subbasins, Valley Water's three drinking water treatment plants, local creeks for recharge and to meet environmental needs, or directly to surface water users. The conjunctive management of surface water and groundwater maximizes water supply

[15] Santa Clara Valley Water District, 2020 Protection and Augmentation of Water Supplies

reliability, allowing Valley Water to store surface water in local groundwater basins to help balance pumping and provide reserves for use during dry years when surface water availability is limited.

Valley Water operates and maintains a complex infrastructure network, integrating natural and constructed systems to capture and convey raw and treated water for a reliable water supply (Figure 1-4). Valley Water's system delivers about 300 million gallons of raw water and 200 million gallons of treated drinking water every day (subject to water demand and hydrologic changes) and includes the following major facilities:

- 10 surface water reservoirs
- 166,000 acre-feet of total reservoir storage capacity
- 17 miles of raw surface water canals
- 102 groundwater recharge ponds covering 277 acres
- 91 miles of controlled in-stream recharge
- 142 miles of pipelines
- three pumping stations
- three drinking water treatment plants
- Silicon Valley Advanced Water Purification Center
- 184 Valley Water owned groundwater monitoring wells

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Figure 1-4. Valley Water's Water Supply Treatment and Distribution System

Long-term water supply and use for the North County is shown in Figure 1-5, and for the less urbanized South County in Figure 1-6.

Figure 1-5. North County Water Supply and Use (2010 to 2019)

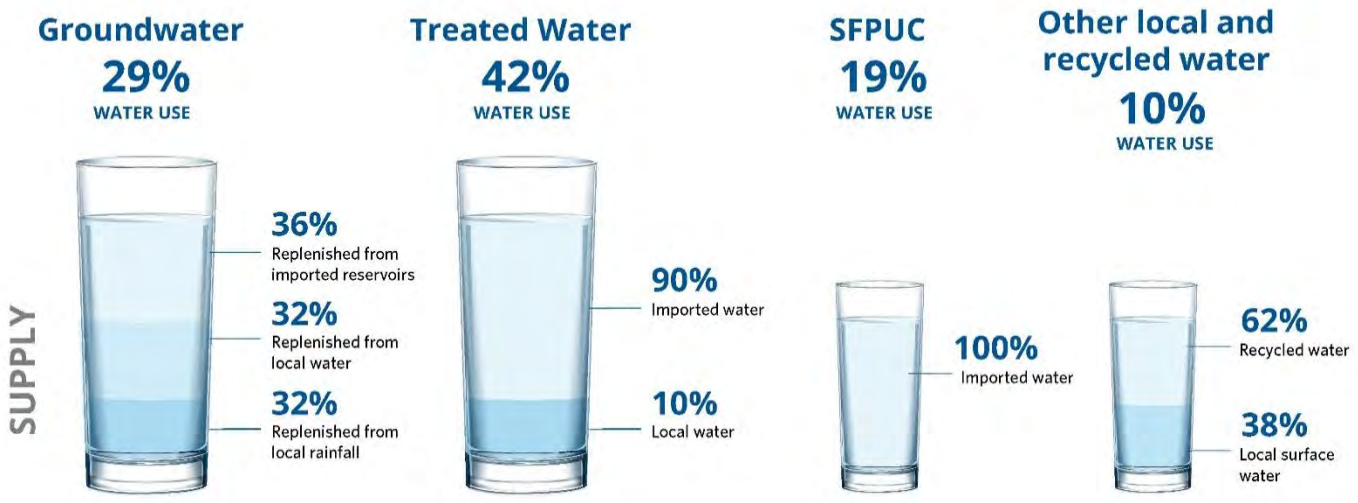
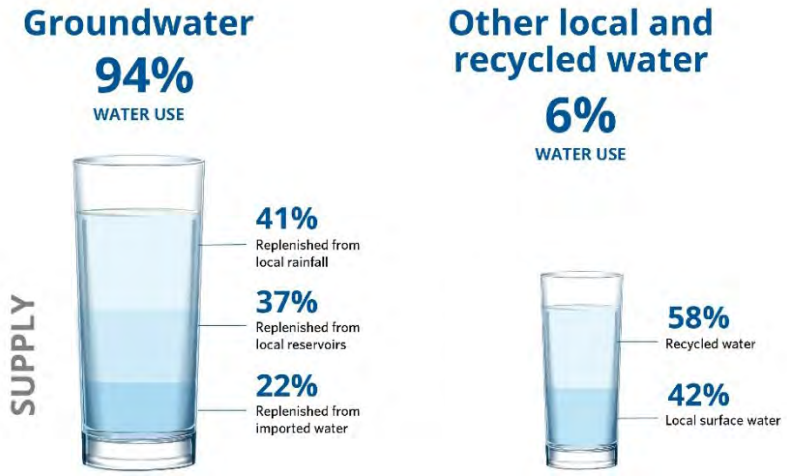


Figure 1-6. South County Water Supply and Use (2010 to 2019)



1.4.1 Valley Water History

Water has played an important part in the development of the county since the Spaniards' arrival in 1776. Unlike indigenous peoples who depended upon the availability of wild food, the Spaniards cultivated food crops and irrigated with surface water. Population growth and the United States' conquest of the area in 1846 increased agricultural demands, which forced the use of groundwater. The first well in San Jose was drilled in 1854. Groundwater was drawn to the surface by windmill pumps or flowed up under artesian conditions.

By 1865, there were almost 500 artesian wells in the valley and already signs of potential misuse. In the valley's newspapers, a series of editorials and letters appeared that complained of farmers and others who left their wells uncapped and blamed them for water shortages and erosion damage to the lowlands.

As a result of several dry years in the late 1890s, more and more wells were installed. Dry winters in the early 1900s were accompanied by a growing demand for the county's fruits and vegetables, which were irrigated with groundwater. The trend of increased irrigation and well drilling continued, causing groundwater levels to drop rapidly. In 1913, a group of farmers asked the federal government for relief from increased pumping costs due to a lower groundwater table. The farmers formed an irrigation district to investigate possible reservoir sites; however, the following year was wet and no action was taken. It was not until 1919 that the Farm Owners and Operators Association presented a resolution to the County Board of Supervisors expressing their strong opposition to the waste resulting from the use of artesian wells, and again raised the issue of building dams to supplement existing water supplies. By that year, subsidence of 0.4 feet had occurred in San Jose.

In 1921, a report was presented to the Santa Clara Valley Water Conservation Committee showing that far more water was being pumped than nature could replace.[16] The committee planned to form a water district differing from others in the State by providing for groundwater recharge. Their effort to form the water district failed, but they were able to implement several water capture and recharge programs. Continued overdraft resulted in a further decline in groundwater levels and additional land subsidence, increasing flood impacts in northern Santa Clara County. Between 1912 and 1932, subsidence ranged from 0.35 feet in Palo Alto to 3.66 feet in San Jose. In 1929, county voters approved the formation of the Santa Clara Valley Water Conservation District (SCVWCD), with the initial mission of stopping groundwater overdraft and subsidence.

The SCVWCD was the forerunner of today's Valley Water, which was formed through the consolidation and annexation of other flood control and water districts within Santa Clara County (Figure 1-7). By 1935, Valley Water had completed the construction of Almaden, Calero, Guadalupe, Stevens Creek, and Vasona dams. Later dams completed include Coyote in 1936, Anderson in 1950, and Lexington in 1952. The Gavilan Water District in the southern portion of the county constructed Chesbro Dam in 1955 and Uvas Dam in 1957. These dams enabled Valley Water to capture surface water runoff and release it for groundwater recharge.

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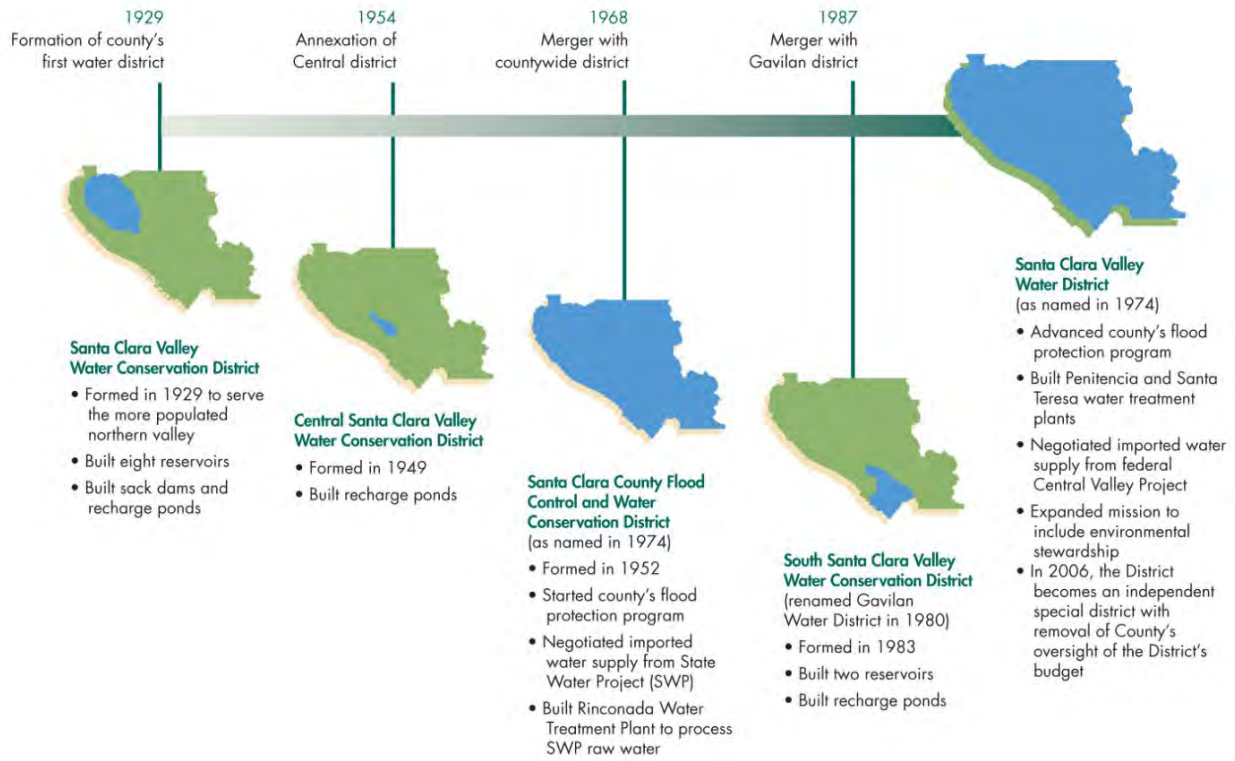
[16] Tibbets F.H. and Kiefer S.E., Santa Clara Valley Water Conservation Project, Report to the Santa Clara Valley Water Conservation Committee, 1921.

Figure 1-7. Valley Water Evolution



The late 1930s to 1947 marked a period of recovery in groundwater levels that reduced the rate of land subsidence. In 1947, conditions became dry, groundwater levels declined rapidly and subsidence resumed. In 1950 almost all the county's water requirements were met by water pumped from the groundwater.

In 1952, the SFPUC began delivering imported water to water retailers in northern Santa Clara County through what is now called the Regional Water System;[17] however, some delivery of this supply into the county took place as early as 1939.[18] By 1960, the population of the county had doubled from that of 1950. To supply this growth, groundwater pumping increased and groundwater levels continued to decline. In addition to continued land subsidence, widespread seawater intrusion of shallow aquifers was observed adjacent to San Francisco Bay in the late 1950s.[19] By the early 1960s, it was evident that the combination of Hetch Hetchy and local water supplies could not meet the area's water demands, so Valley Water entered into a contract with the State to receive up to 100,000 AF of State Water Project (SWP) water per year through the South Bay Aqueduct (SBA).

With this new source of supply, Valley Water added a new tool to its groundwater management toolbox: treated surface water sales to offset demand that would otherwise be met through groundwater pumping. Valley Water constructed its first water treatment plant (WTP), the Rinconada WTP. In 1967, Valley Water started delivering treated surface water to North County residents, thus reducing the need for pumping in the Santa Clara Plain. This helped lead to a recovery of groundwater levels and reduced rate of land subsidence.

[17] The Regional Water System used to be called the Hetch Hetchy southern aqueduct.
[18] Per personal communication with City of Palo Alto staff, the City of Palo Alto began receiving water from SFPUC in 1939 through a different connection.
[19] Santa Clara Valley Water District, Saltwater Intrusion Investigation, September 1980.

From 1960 to 1970, the county's population nearly doubled yet again, with the semiconductor and computer manufacturing industries contributing over 30 percent of the job growth. The growth and prosperity of the county continued, and jobs grew nearly 40 percent between 1970 and 1980. In 1974, Penitencia (Valley Water's second WTP) started delivering treated water. In response to the 1976-1977 drought, Valley Water began its first programs related to conservation education and outreach.

The county's explosive growth and transformation from a predominantly agricultural economy was not without its problems. In the early 1980s, groundwater contamination was brought to the forefront when large underground tanks storing solvents for computer-related manufacturing processes in south San Jose were discovered to be leaking. In 1981, Fairchild Semiconductor Corporation notified Valley Water that "a substantial amount of chemicals were missing from their tanks and that a leak was suspected." Subsequent testing of a nearby public water supply well revealed significant contamination, which resulted in shutdown of the well. Valley Water, the Regional Water Quality Control Board, and the Department of Health Services[20] worked together to sample water supply wells in the county and search for other leaking tanks, resulting in the identification of additional contaminant release sites.

In the 1980s, Valley Water significantly increased its efforts to protect groundwater quality. Valley Water worked with the Santa Clara County Fire Chiefs Association, the City Managers Association, and environmental groups to develop a countywide Hazardous Materials Storage Permit Ordinance. The ordinance, adopted by the Santa Clara County Intergovernmental Council, set tough new standards on hazardous material storage and handling. This first- in-the-nation ordinance served as an example and the state and federal government soon passed similar laws. Valley Water also developed standards for the construction and destruction of wells, the majority of which were being installed for the investigation and cleanup at contaminant release sites. Valley Water's abandoned well program was developed to address existing wells that were no longer in use and posed a threat to groundwater resources by acting as vertical conduits that could allow contaminants to migrate directly from shallow to deep aquifers.

In the late 1980s, Valley Water began oversight of petroleum hydrocarbon leaking Underground Storage Tank (UST) sites in Santa Clara County. From 1988 through 2004, Valley Water provided oversight for the investigation and cleanup of over 2,500 UST sites. Valley Water's fuel leak program became nationally known for its proactive and innovative approaches and influenced the direction of the State's UST cleanup program. By the time Valley Water transferred the program to the Santa Clara County Department of Environmental Health (DEH) in July 2004, less than 400 fuel leak cases remained open.

Groundwater pumping accounted for about half of the total water use by the mid-1980s. The rate of inelastic land subsidence was reduced to about 0.01 feet per year compared to 1 foot per year in 1961. To provide a reliable source of supply, Valley Water contracted with the federal government for the delivery of up to 152,500 AF per year of imported water from the Central Valley Project (CVP) through the San Felipe Project. The county's first delivery of CVP water took place in 1987, but it was not until 1989 that Valley Water's Santa Teresa WTP began operating to fully utilize this additional source of imported supply.

The extended drought from 1987 to 1992 led to expanded Valley Water conservation programs, including more aggressive outreach campaigns and rebate programs for residents and businesses installing water saving fixtures. In the mid-1990s, Valley Water began offering financial and technical assistance to entities interested in expanding the use of recycled water. This included agreements with the cities of San Jose, Santa Clara, and Milpitas (the South Bay Water Recycling Program); Gilroy and Morgan Hill (the South County Regional Wastewater Authority); Sunnyvale; and Palo Alto and Mountain View. This commitment to supplementing local supplies with recycled

[20] Now the State Division of Drinking Water.

water was strengthened in 1997 when Valley Water's Board established a policy supporting the expanded use of recycled water and setting numeric targets for future recycled water use.

Nitrate and methyl tertiary butyl ether (MTBE) emerged as significant groundwater quality threats in the 1990s. Elevated nitrate from agriculture, septic systems, and animal wastes was identified as early as the 1950s; however, the concern became more acute in the early 1990s as an increasing number of wells were impacted. Valley Water developed a comprehensive Nitrate Management Plan, which included public outreach programs to educate residents on fertilizer use, septic system maintenance, and well location and construction. Valley Water also offered free nitrate testing for South County residents in 1998. Later efforts included programs to reduce nitrate loading in cooperation with farmers, including programs to evaluate infield nutrient use.

In 1992, California began using oxygenates, primarily MTBE, in gasoline to satisfy federal clean air requirements, Valley Water began investigating the potential for MTBE contamination in 1995, which led to the discovery of MTBE contamination in soil at 292 sites, primarily service stations, and at low concentrations in Valley Water's reservoirs. Valley Water provided the first guidelines in the State for owners of leaking underground storage tank sites on how to identify and clean up MTBE releases in 1997. Along with many others, Valley Water's action and leadership in addressing MTBE led to a statewide ban in 2004.

In the 2000s, Valley Water again demonstrated its leadership and commitment to aggressively protecting groundwater resources. Perchlorate contamination at a former flare manufacturing facility in Morgan Hill was discovered in August 2002, and further site investigation by the responsible party indicated detections in wells several miles to the south. Due to concerns that the contamination could be larger than assumed, Valley Water sampled over 1,000 wells. Related results prompted the Central Coast Regional Water Quality Control Board to expand and expedite site investigation and cleanup activities. To ensure the safety of South County residents who rely on groundwater for their drinking water, Valley Water also initiated a temporary bottled water program for well owners impacted by perchlorate. While significant cleanup progress has been made, Valley Water continues to work with the Central Coast Regional Water Quality Control Board and local stakeholders to ensure contaminated groundwater is cleaned up as soon as possible.

Recent efforts to ensure long-term water supply reliability include the construction and operation of Valley Water's Silicon Valley Advanced Water Purification Center. This facility, which began operating in 2014 produces up to 8 million gallons per day of purified water by treating tertiary-treated recycled water with microfiltration, reverse osmosis, and ultraviolet light. Purified water is blended with tertiary treated recycled water to lower the salt content of recycled water used for landscape irrigation and industrial uses. This facility supports Valley Water's goal of expanding the use of recycled water, which reduces the demand on groundwater, and sets the stage for the potential recharge of groundwater with purified water.

With the passage of SGMA in 2014, Valley Water was listed as one of 18 exclusive agencies with powers to comply with SGMA within its statutory boundary.[21] In May 2016, following a public hearing, the Valley Water Board adopted a resolution to become the GSA for the Santa Clara and Llagas subbasins. Valley Water's authority to sustainability manage groundwater is established in the District Act and as the designated GSA.

1.4.2 Valley Water Authority

Valley Water is an independent special district formed by the California legislature under the District Act for the primary purpose of providing comprehensive management for all beneficial uses and protection from flooding within Santa Clara County.

[21] California Water Code Section 10723 (a).

1.4.2.1 Authorities Provided by the District Act

Per Sections 4 and 5 of the District Act, Valley Water's objectives and authority related to groundwater management are to recharge groundwater basins, conserve, manage and store water for beneficial and useful purposes, increase water supply, protect surface water and groundwater from contamination, prevent waste or diminution of Valley Water's water supply, and do any and every lawful act necessary to ensure sufficient water is available for present and future beneficial uses.

The District Act gives the Board the ability to adopt ordinances to carry out the District Act, including the objective to protect the county's groundwater resources. One such ordinance regulates the construction and destruction of wells and other deep excavations.[22]

The District Act also provides Valley Water the authority to create zones of benefit, to levy volumetric groundwater charges, and to use those revenues to pay the costs of:

- constructing, maintaining, and operating facilities that import water into the county;
- purchasing imported water;
- constructing, maintaining, and operating facilities that will conserve or distribute water within the groundwater charge zones, including facilities for groundwater recharge, surface distribution, and water purification and treatment; and
- principal or interest incurred by Valley Water for the previously listed purposes.

Per the District Act, groundwater charges are to be fixed and uniform within each zone, with the rate for agricultural water not to exceed one-quarter of the rate for non-agricultural water. A groundwater production rate may be subject to an increase in proportion to groundwater production over a prior "base period" specified by the Board upon a finding by the Board that conditions of drought and water shortage require the increase.[23] Proportional rates have not been implemented by Valley Water to date.

1.4.2.2 Authorities Provided by SGMA

In addition to the broad authorities provided by the District Act, SGMA provides several additional specified powers to Valley Water. Such powers, or legal authorities, under SGMA include the ability to regulate groundwater pumping and assess different types of groundwater charges as potential tools to support continued groundwater sustainability.

Regulation of Groundwater Pumping

Per Water Code Sections 10725 and 10726.4, in regulating groundwater extraction, SGMA allows a GSA with an adopted Plan to:

- impose spacing requirements on new well construction to minimize interference;
- impose reasonable operating regulations on existing wells to minimize interference, including requiring extractors to operate on a rotation basis;
- regulate, limit, or suspend groundwater extraction, construction of new wells, enlargement of existing wells, or reactivation of abandoned wells;
- establish groundwater extraction allocations;

[22] Santa Clara Valley Water District Ordinance 90-1.
[23] Santa Clara Valley Water District Act §§26.7 (3)(c).

- authorize temporary and permanent transfers of groundwater extraction allocations; and
- establish rules to allow unused groundwater extraction allocations to be carried over from one year to another and voluntarily transferred.

While these authorities are listed in the Water Code, SGMA also acknowledges limitations related to the regulations of pumping. Several related SGMA sections state that local agencies are not authorized to make a binding determination of the water rights of any person or entity.[24] Property owners and municipalities have rights to the reasonable, beneficial use of groundwater. Other pumpers have established appropriative rights and may also claim prescriptive rights to local groundwater. The authorities granted by SGMA to regulate groundwater pumping have not been tested.

Research into the use of similar authorities in other jurisdictions indicates that few agencies regulate pumping and highlights related challenges. Where used, pumping regulation has been in response to significant basin problems like long-term overdraft or seawater intrusion, most commonly through the well permitting process. These agencies have struggled with well owner concerns, enforcement, and legal challenges. Others have decided against regulation due to concerns with water rights and the potential to trigger adjudication, focusing instead on financial incentives or groundwater replenishment.

Local agencies evaluating the regulation of pumping must also consider the land use authority of cities and counties, which is not superseded by SGMA.[25] For example, any action to control extractions must be consistent with the city or county general plan unless there is insufficient sustainable yield in the basin to serve a designated land use. Groundwater extraction transfers are also subject to applicable city and county ordinances.

While long-term groundwater conditions are sustainable due to a strong groundwater management framework and coordination with water retailers, risks to ongoing sustainability include prolonged drought, increased demands, reduced imported water availability, aging infrastructure, and climate change. Continued coordination and partnerships with major pumpers and other local agencies are the preferred way to deal with these and other challenges to groundwater sustainability. However, the regulation of pumping may be needed if these risks threaten to, or produce undesirable results like chronic overdraft, land subsidence, or groundwater quality impacts.

On November 22, 2016, the Board adopted the 2016 GWMP following a public hearing. Several related comment letters expressed concerns with authorities provided by SGMA, including water rights and the potential regulation of pumping. The Board referred stakeholder engagement in evaluating new SGMA authorities to the Water Conservation and Demand Management Committee (Committee). The Committee met nine times between December 2016 and December 2017 to evaluate new SGMA authorities in coordination with water retailers and other interested stakeholders. Through this open forum and with retailer and stakeholder participation, the Committee developed a process (an implementation framework) for groundwater extraction regulation. On February 27, 2018, Valley Water's Board of Directors adopted resolution no. 18-04 (Appendix F) that memorializes the process to regulate groundwater extraction under SGMA, if needed. The resolution lays out an implementation framework for Valley Water, in coordination with stakeholders, to address worsening basin conditions.

Board resolution no. 18-04 acknowledges that effective programs, investments, and coordination have resulted in sustainable groundwater conditions, and that collaboration with groundwater users and stakeholders will continue to be the preferred approach to address observed or projected undesirable results. As an example of this strong collaboration, during the 2012–2016 drought, nearly all water retailers supported Valley Water's water use reduction target, which was higher than their state-mandated targets in many cases. Retailer efforts to use treated

[24] California Water Code §§10720.5(b) and 10726.8(b).
[25] California Water Code §§ 10726.4, 10726.8(f), and 10726.9.

surface water and reduce pumping in certain areas were instrumental in groundwater level recovery and minimizing the risk of resumed land subsidence.

Board resolution no. 18-04 acknowledges that the existing groundwater management framework is expected to support continued, sustainable groundwater conditions and that pumping regulation may never be needed. The resolution describes the fundamental approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction. The focus is on providing transparency and certainty as to the process, while avoiding prescriptive requirements that may not be appropriate or effective. The basic steps of the process are summarized below.

1. Normal Operations: evaluate groundwater conditions, coordinate with water retailers, and receive stakeholder input
2. Issue Identified: identify new regulatory requirement or observed/projected undesirable result
3. Preliminary Assessment: prepare memo describing issue and potential mitigation (e.g., additional supplies and/or demand reduction)
4. Initial Stakeholder Consultation: meet with affected pumpers and/or other stakeholders to discuss issue and preliminary assessment
5. Action Plan: develop draft action plan with stakeholder input, including desired outcome, roles, actions, schedule, monitoring, and reporting
6. Voluntary Action (Preferred): agree to implement voluntary actions to address issue (preferred)
7. Potential Well/Pumping Regulation, if Needed: develop Board ordinance to implement SGMA authorities through Committee and public process
8. Implementation, Monitoring, and Reporting: implement voluntary and/or mandatory actions described in the action plan and/or ordinance, monitor, and report out to Board and stakeholders

The resolution also documents Valley Water's guiding principles regarding the process to regulate extraction, if needed, under the SGMA authorities.

1. Valley Water will sustainably manage local groundwater as part of our mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy.
2. Valley Water will continue to conduct comprehensive water supply planning and invest in diverse water supplies to ensure reliability and avoid chronic shortages.
3. Through ongoing water supply operations, Valley Water will continue to optimize the use of available water supplies while protecting groundwater storage.
4. Transparency in fulfilling Valley Water's mission remains an important driver and Valley Water will continue to encourage input and participation from all interested stakeholders.
5. Valley Water will continue to seek solutions that effectively and efficiently address identified water supply issues as they arise.
6. Valley Water will work with water retailers and other stakeholders to continue to improve our understanding and management of groundwater basins and conditions, including sustainable use.
7. Strong partnerships with water retailers and other large groundwater users have been effective in avoiding undesirable results and are critical to future sustainability.

8. Collaboration with groundwater users and interested stakeholders will continue to be the preferred approach to address observed or projected undesirable results, and Valley Water regulation of pumping will only be considered if there is no viable alternative.
9. Given the uncertainty in the timing, location, and severity of potential future undesirable results, the process to regulate groundwater extraction avoids prescriptive triggers and requirements, instead, it clarifies how to respond to worsening conditions. This will maintain maximum flexibility to respond to changing conditions and avoid unnecessary or ineffective actions.

Collection of Various Fees

Water Code Section 10730.2 allows GSAs to impose fixed fees and volumetric fees, including, but not limited to, fees that increase based on the quantity of groundwater produced, the year in which the groundwater extraction commenced, and impacts to the basin. Any proposed changes to Valley Water's rate structure would be identified as part of the annual rate setting process. This open and transparent process includes documentation of proposed rates in Valley Water's annual Protection and Augmentation of Water Supplies (PAWS) Report, notification to all owners of groundwater producing facilities, discussion with Board Advisory Committees and water retailers, and public hearings prior to rate adoption.

In 2018, Valley Water in conjunction with its retail customers explored the idea of implementing a fixed charge that would complement its volumetric groundwater charge, in order to minimize the revenue impact associated with water use decreases, such as in a drought. Water retailer generally strongly opposed a fixed charge for various reasons. As a result, staff recommended suspending the effort to implement a fixed charge at the full Board meeting on November 27, 2018. Subsequently, Valley Water's Water Conservation and Demand Management Committee reviewed the reasons for water retailer opposition at its March 25, 2019 meeting, and agreed with staff's recommendation to not proceed with further development of a fixed charge at that time. However, implementation of a fixed charge remains a potential option for Valley Water in the future.

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1.4.3 Valley Water Management Structure

Valley Water is governed by an elected Board of Directors. The Board is comprised of seven members, each elected from equally divided districts drawn through a formal process. The purpose of the Board, on behalf of Santa Clara County, is to provide Silicon Valley safe, clean water for a healthy life, environment and economy.

Valley Water Board of Directors

There are four Board Appointed Officers (BAOs): Valley Water Counsel, Clerk of the Board, Chief Executive Officer (CEO), and Assistant Chief Executive Officer (ACEO). The executive management team is responsible for implementing the Board policies and running the day-to-day operations. At the staff level, there are two Valley Water chiefs (Chief Operating Officer for Watersheds and Chief Operating Officer for the Water Utility Enterprise) that report to the ACEO and three chiefs that report to the CEO (Chief Administrative Officer, Chief of External Affairs, and the Chief Financial Officer). The Water Utility Enterprise includes four divisions: Water Supply, Raw Water, Treated Water, and Water Utility Capital. The divisions and units within the Water Utility Enterprise manage Valley Water programs, facilities, and planning to ensure reliable water supplies for the county.

1.4.4 Water Utility Enterprise Financial Overview

Funding sources for the Water Utility Enterprise include charges for groundwater production, treated water, recycled water, and surface water, along with property taxes, interest earnings, reimbursements, and grants. These funds are used to operate and maintain Valley Water's complex water supply infrastructure network, maintain water supply sources and water rights, and make capital improvements as needed to ensure water supply reliability. The Water Utility Enterprise operations and capital budget for fiscal year 2021-22 is $580 million. Detailed information on Water Utility Enterprise funding is available through Valley Water's PAWS report, which is prepared each year in February and posted on Valley Water's website. Valley Water's overall budget is also available at www.valleywater.org.

1.4.5 Relation to Other Valley Water Programs and Plans

The 2021 GWMP provides information on basin conditions and documents groundwater management goals, strategies, related activities, and metrics for desired basin outcomes. This information supports other Valley Water planning efforts including the:

- Urban Water Management Plan (UWMP) that evaluates water supply reliability over a 25-year period
- Water Supply Master Plan that documents the water supplies, infrastructure, investments, and operating strategies needed to ensure long-term water supply reliability
- Annual Protection and Augmentation of Water Supplies (PAWS) Report that presents the basis for recommended groundwater production charges in accordance with the District Act
- Planning to address specific water management issues that could affect groundwater management
- One Water plan that provides a decision-making framework for strategically allocating limited resources

As required by the Water Code, Valley Water will update the GWMP at least every five years. The GWMP, UWMP, and WSMP are related planning documents that collectively help guide Valley Water's sustainable groundwater management activities. The UWMP is also on a five-year update cycle, and the 2020 UWMP was adopted by the Board in June 2021. The WSMP builds on the information in the both the GWMP and UWMP to update Valley Water's long-term water supply strategy and is also on a five-year update cycle.

1.5 GROUNDWATER MANAGEMENT PARTNERS AND STAKEHOLDERS

Although Valley Water is the groundwater management agency in Santa Clara County per the District Act and is now the GSA under SGMA, many other agencies have a significant role, including local water retailers, land use agencies, and regulatory agencies. These partners and stakeholders are described next.

1.5.1 Water Retailers

Local water retailers maintain facilities to distribute water directly to local residents and businesses and meet applicable regulatory standards established by the U.S. Environmental Protection Agency (USEPA) and California Division of Drinking Water (DDW). In addition to groundwater, local retailers may also serve treated surface water from Valley Water or potable water supplied by the SFPUC. Several retailers also maintain local surface water rights and distribute recycled water for non-potable uses. The maintenance of these supplies is critical to maintaining overall water supply reliability in the county. Every five years, Valley Water and local water retailers coordinate to develop individual agencies' Urban Water Management Plans that evaluate water supply reliability over a 25-year period. For water retailers using groundwater, these plans show a continued reliance on groundwater in the future.

As the primary groundwater pumpers in the county, water retailers play a major part in influencing groundwater conditions through their operations. Effective coordination between Valley Water and retailers with the shared goal of protecting groundwater resources has resulted in sustainable groundwater conditions over many decades. As noted previously during the 2012–2016 drought, the ability of water retailers to significantly reduce groundwater pumping in 2015 through source shifts and water use reduction efforts was instrumental in groundwater recovery despite continued dry conditions. Ongoing strong partnership and collaboration will be essential to meet future water supply challenges during the current (2021) drought.

Valley Water and water retailers collaborate closely on operations as well as long-term planning and meet quarterly through the Water Retailers Committee. The Water Retailers Committee has established the following subcommittees, which meet regularly to discuss specific topics in more detail:

- Water Supply
- Groundwater
- Water Quality
- Treated Water

- Fluoridation
- Water Conservation
- Recycled Water
- Finance
- Emergency Management
- Communications

1.5.2 Land Use Agencies

Land use agencies, including Santa Clara County and local cities, provide land use planning and permitting functions affecting water demand and land use, which may impact groundwater quantity and quality. General Plans adopted by land use agencies reflect each agency's policy about future development and many of these plans contain goals to address water supply reliability and the protection of water resources, including groundwater. Land use agencies also review and approve Water Supply Assessments for developments meeting certain growth requirements. Valley Water reviews General Plans and Water Supply Assessments to ensure alignment with Valley Water policy, water supply goals, and planning assumptions.

Land use agencies permit and inspect hazardous material and waste storage and handling facilities through the fire departments. The County Department of Environmental Health (DEH) also oversees the leaking underground fuel tank cleanup program, issues permits for septic systems, and regulates drinking water systems with 5 to 14 connections. Local land use agencies also administer stormwater management programs in compliance with National Pollutant Discharge Elimination System (NPDES) requirements.

1.5.3 Local, State, and Federal Agencies

Valley Water relies on partnerships with regulatory agencies to protect groundwater resources. Agencies, including the State Water Resources Control Board, the Department of Toxic Substances Control (DTSC), and the USEPA, regulate the cleanup of contaminants in groundwater. Regional Water Quality Control Boards (Water Boards) also define the beneficial uses and water quality objectives for groundwater basins. The San Francisco Bay Water Board has regulatory jurisdiction over the Santa Clara Subbasin and the Central Coast Water Board has regulatory jurisdiction over the Llagas Subbasin.

Figure 1-8 shows the general authorities, roles, and functions of these various agencies with regard to groundwater resources. It should be noted that this figure is intended to provide a general overview rather than a comprehensive list of individual agencies and functions.

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Figure 1-8. Overview of Groundwater Management Roles

U.S. Environmental Protection Agency

- Establishes federal drinking water standards for public water systems
- Regulates cleanup of Superfund sites

California Environmental Protection Agency
Includes: State Water Resources Control Board, Regional Water Quality Control Boards, Division of Drinking Water, Department of Toxic Substances Control

- Implements environmental protection laws that ensure clean air, clean water, clean soil, safe pesticides and waste recycling and reduction
- Allocates water rights and adjudicates water right disputes
- Develops statewide water protection plans and establishes water quality standards
- Regulates groundwater if local management efforts are inadequate under the Sustainable Groundwater Management Act (SGMA)
- Establishes state drinking water standards and regulates public drinking water systems
- Permits recycled water projects
- Regulates facilities that treat, store, and dispose of hazardous waste
- Regulates cleanup of contaminated sites

California Department of Water Resources

- Develops regulations, evaluates local groundwater sustainability planning efforts, and provides technical assistance related to SGMA
- Operates the State Water Project
- Supports local and regional water management through technical and financial assistance
- Guides development and management of water resources

Santa Clara Valley Water District

- Manages the Santa Clara and Llagas Subbasins in Santa Clara County per the District Act and SGMA
- Implements programs to protect and augment groundwater
- Conducts managed recharge and in-lieu recharge programs to offset groundwater pumping
- Permits wells and other deep excavations
- Coordinates with water retailers, land use and regulatory agencies, adjacent water agencies, and interested stakeholders

Water Retailers

- Maintain facilities to deliver water to customers
- Maintain surface water rights and/or other sources of supply
- Ensure compliance with drinking water standards
- Reduce demands during shortages and modify operations to protect groundwater

Land Use Agencies

- Develop General Plans and review Water Supply Assessments
- Permit land use and administer stormwater management programs
- Permit hazardous material storage and handling facilities
- Oversee cleanup of leaking underground tanks (County)
- Regulates septic systems and small water systems (County)

Well Owners and the Community

- Maintain, construct, and properly destroy wells (well owners)
- Use water wisely and minimize the introduction of contaminants

1.5.4 Other Stakeholders

Private well owners, non-governmental organizations, and the public are also important partners in protecting groundwater supplies. Private well owners are responsible for constructing, maintaining, and properly destroying wells so they do not act as vertical pathways for contaminants. The community also has a role in protecting groundwater supplies by using water wisely and helping reduce the introduction of contaminants from activities at the land surface.

There are also numerous statewide and national organizations engaged in issues related to groundwater, including the Association of California Water Agencies and the California Urban Water Agencies. Valley Water works with these agencies and others on various proposals to protect groundwater resources.

Valley Water will continue to work closely with local partners and the public using the following methods:

- Regularly scheduled meetings, including the Water Retailer Committee and Groundwater Subcommittee
- Publicly noticed Board meetings
- Review and coordination with land use agencies on land use and development proposals as well as the development of guidelines related to specific issues (e.g., stormwater infiltration, graywater, and septic systems)
- Technical coordination with regulatory agencies on contaminant release sites and policies related to groundwater
- Coordination with basin stakeholders and regulatory agencies on long-term resource planning efforts
- Outreach, including the development of fact sheets and web information and interaction with the public at open houses and other events

1.6 PUBLIC OUTREACH FOR THE 2021 GROUNDWATER MANAGEMENT PLAN

Under SGMA, Alternatives are not subject to the same outreach required during development and adoption of a GSP. However, Valley Water provided interested stakeholders numerous opportunities for input during the development of this 2021 GWMP.

Valley Water presented updates and information on the 2021 GWMP at nearly all of the 2020 and 2021 joint meetings of the Water Retailers Water Supply and Groundwater Subcommittees. Valley Water has also discussed planned SGMA compliance with agencies in adjacent subbasins, including the Alameda County Water District, San Benito County Water District, and San Mateo County. Updates on SGMA compliance were presented at many of the 2020 and 2021 meetings of the Board's Water Conservation and Demand Management Committee, which are publicly noticed. Valley Water also provided updates on progress and related Committee and Board items via email notifications to all members of the interested parties stakeholder list.

Due to the pandemic, Valley Water held a virtual public informational meeting about the 2021 GWMP on August 12, 2021 via Zoom. This meeting provided the public context about the 2021 GWMP update prior to Valley Water publicly releasing its draft 2021 GWMP on October 8, 2021. The draft 2021 GWMP was posted on Valley Water's website and a corresponding email was sent to the interested parties list informing them of the draft report and opportunity to provide comments.

A public hearing on the 2021 GWMP was held at a regularly scheduled Board meeting on November 23, 2021 and public notice included advertisements in local newspapers in compliance with Government Code 6066. Related notices, Board resolution, public comments received, Valley Water responses, and environmental documentation are included in Appendix A.

1.7 PLAN CONTENT AND ORGANIZATION

This 2021 GWMP brings together important information on groundwater management goals, strategies, and related activities in Santa Clara County. In addition to meeting SGMA regulatory requirements, the GWMP is intended to present information that will be useful to water retailers, land use planning agencies, agencies in adjacent subbasins, and community members interested in groundwater. The 2021 GWMP includes the following chapters:

- **Chapter 2 – Santa Clara Subbasin Description**: This chapter provides an overview of the Santa Clara Subbasin and current conditions.
- **Chapter 3 – Llagas Subbasin Description**: This chapter provides an overview of the Llagas Subbasin and current conditions.
- **Chapter 4 – Water Supplies, Demands, and Budget**: This chapter describes Valley Water's conjunctive water management system, historical and current groundwater demands, and groundwater budgets.
- **Chapter 5 – Sustainable Management Criteria**: This chapter describes the sustainability goals and sustainability criteria to measure the effectiveness of the sustainability goals.
- **Chapter 6 – Basin Management Programs and Activities**: This chapter describes Valley Water programs and activities that support the sustainability goals.
- **Chapter 7 – Groundwater Monitoring and Modeling**: This chapter summarizes Valley Water programs to monitor changes in groundwater levels, groundwater quality, land subsidence, and surface water, as well as groundwater flow models.
- **Chapter 8 – Next Steps**: This chapter describes future reporting related to the GWMP and discusses potential approaches to consider if the outcome measures indicate improvement is needed or to address future risks and changing conditions. It also includes recommendations for further work.

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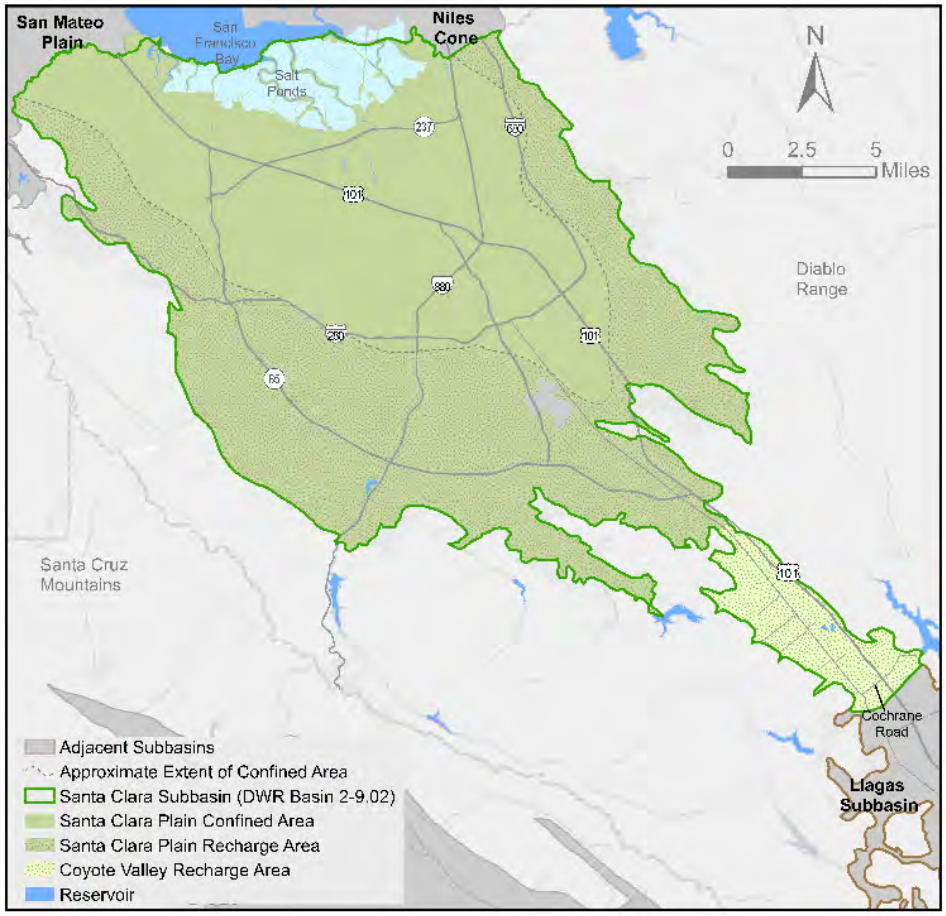
CHAPTER 2 – SANTA CLARA SUBBASIN DESCRIPTION

This chapter describes the Santa Clara Subbasin, including the physical setting and characteristics, and conditions related to groundwater elevation, water quality, land subsidence, groundwater/surface water interaction, groundwater dependent ecosystems (GDEs), and seawater intrusion.

2.1 BASIN SETTING

The Santa Clara Subbasin (DWR Basin 2-9.02), which includes the Santa Clara Plain and Coyote Valley groundwater management areas, is located within the California Coast Ranges physiographic province between the San Andreas and Hayward Faults at the southern end of the San Francisco Bay (Figure 2-1). The subbasin underlies a relatively flat valley and consists of unconsolidated alluvial sediments. The Santa Clara Subbasin is part of Basin 2-9, which extends beyond Santa Clara County into San Mateo, Alameda, and Contra Costa counties and beneath San Francisco Bay, which is fringed and underlain by the estuarine San Francisco Bay mud.[26] Due to different hydrogeologic, land use and water supply management characteristics, Valley Water further subdivides the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.

Figure 2-1. Santa Clara Subbasin



[26] USGS, Physical Subdivision and Description of the Water-Bearing Sediments of the Santa Clara Valley, California, 2015.

2.1.1 Lateral Subbasin Boundaries

The Santa Clara Subbasin covers a surface area of 297 square miles and forms a northwest-trending, elongated valley bounded by the Santa Cruz Mountains to the west and the Diablo Range to the east. The basis for the lateral boundary delineation shown in Figure 2-1 is the geologic, hydrologic and topographic features in the subbasin. The western and eastern subbasin boundaries are the geologic contact between permeable to semi-permeable alluvial sediments within the Santa Clara Valley and the impermeable bedrock of the adjacent mountain ranges. These impermeable sediments include the Mesozoic marine formations and the Franciscan Assemblage of the Santa Cruz Mountains, and Franciscan greywacke and serpentinite bodies of the Diablo Range. The northern boundary with the San Francisco Bay is hydrologic. To the northwest and northeast, the subbasin borders the San Mateo Plain and Niles Cone subbasins, respectively, at institutional boundaries formed by county boundaries. The southern boundary with the Llagas Subbasin is the Coyote Creek alluvial fan in the Morgan Hill area, which forms a topographic and hydrologic divide between the groundwater and surface water flowing to the San Francisco Bay and water flowing to the Monterey Bay. The groundwater divide is approximately located at Cochrane Road in Morgan Hill. Based on observed water level data, the boundary moves as much as a mile to the north or south depending on local groundwater conditions.

The Santa Clara Plain covers 280 square miles, extending from southern San Francisco Bay to the Coyote Narrows, near Metcalf Road. The Coyote Valley extends from the Coyote Narrows to the boundary with the Llagas Subbasin. The Coyote Valley is much smaller than the Santa Clara Plain, covering a surface area of 17 square miles.

2.1.2 Recharge Areas

Recharge within the Santa Clara Subbasin generally occurs along the margins and southern portion of the subbasin where coarse-grained sediments predominate. The recharge area includes the alluvial fan and fluvial deposits along the edge of the subbasin where high lateral and vertical permeability allow surface water to infiltrate the aquifers. The percolation of surface water in recharge areas replenishes unconfined groundwater within the recharge area and contributes to the recharge of principal aquifers in the confined area through subsurface flow.

The Santa Clara Plain has two hydrogeologic areas, the recharge (unconfined) and confined areas (Figure 2-1). The confined area is located in the central portion where a laterally extensive, low permeability aquitard restricts the vertical flow of groundwater and contaminants. The confined area boundary is approximate and is a simplification of natural conditions based on the extent of artesian wells.[27] There is no laterally extensive aquitard in the Coyote Valley, with generally high lateral and vertical permeability throughout the area.

2.1.3 Principal Aquifers and Aquitards

The Santa Clara Subbasin is a trough-like depression filled with Quaternary alluvium deposits of unconsolidated gravel, sand, silt and clay that eroded from adjacent mountain ranges by flowing water and were deposited into the valley (Figure 2-2). The alluvium comprises interfingering alluvial fans, stream deposits and terrace deposits.

Helley and Lajoie (1979) divided the valley fill alluvium into two major Quaternary deposits: Holocene (younger than 10,000 years old) and Pleistocene deposits (from 1.8 Million to 10,000 years old).[28] The Holocene deposits consist of the most recent sediments deposited along major stream courses and bay mud deposits along the San Francisco Bay. The Holocene alluvial sediment consists mainly of clay, silt and sand occurring in discontinuous lenses. The majority of the subbasin alluvium is older, Pleistocene deposits of unconsolidated and interfingered

[27] Clark, Ground Water in Santa Clara Valley, California, 1924.
[28] Helley and Lajoie, Flatland Deposits of the San Francisco Bay Region, California: Their Geology and Engineering Properties and Their Importance to Comprehensive Planning, 1979.

lenses of clay, silt, sand and gravel. The base of the Pleistocene deposits overlies the Santa Clara Formation in some areas of the subbasin, such as near Stevens Creek Reservoir. The Santa Clara Formation is composed of slightly or semi-consolidated alluvial deposits washed down from the upper mountainous area and deposited along the foothills beneath the unconsolidated young alluvial sediments of the subbasin.[29] A 2015 USGS study[30] indicated that Late Pleistocene alluvium is exposed on the heads of the alluvial fans, particularly on the west side of the valley.

The thickness of aquifer materials in the Santa Clara Plain ranges from about 150 feet near the Coyote Narrows to more than 1,500 feet in the interior of the subbasin. The alluvium thins towards the western and eastern edges of the Santa Clara Plain. The central portion of the Santa Clara Plain contains a laterally extensive, low permeability aquitard that restricts the vertical flow of groundwater. This major aquitard varies in thickness from 20 to 100 feet and typically occurs at depths between 100 to 200 feet below ground surface,[31] separating shallow and principal aquifer zones. Shallow aquifer zones generally refer to aquifers that occur within 150 feet of ground surface, while principal aquifer zones generally occur at depths below 150 feet.[32] Generally, the shallow aquifer is not used for water supply. The primary confined aquifers exist at depths between 200 and 1,000 feet.[33]

The Coyote Valley is mainly composed of thick alluvial sand and gravel deposits with interbedded thin, discontinuous clays. The aquifer sediments overlying the Santa Clara Formation vary in thickness from a few feet along the west side of the valley to more than 400 feet along the east side. Cross-sections of the Santa Clara Subbasin, including the Santa Clara Plain and Coyote Valley are shown in Figures 2-3 through 2-5.

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[29] Dibblee, Preliminary Geologic Map of the San Jose East Quadrangle, Santa Clara County, California, 1972.
[30] USGS, Physical Subdivision and Description of the Water-Bearing Sediments of the Santa Clara Valley, California, 2015.
[31] SCVWD Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County, 1989.
[32] Iwamura, Hydrogeology of the Santa Clara and Coyote Valleys Groundwater Basins, California, 1995.
[33] Carroll, 1991; Iwamura, 1995.

Figure 2-2. Quaternary Alluvium Geologic Map of the Santa Clara Subbasin

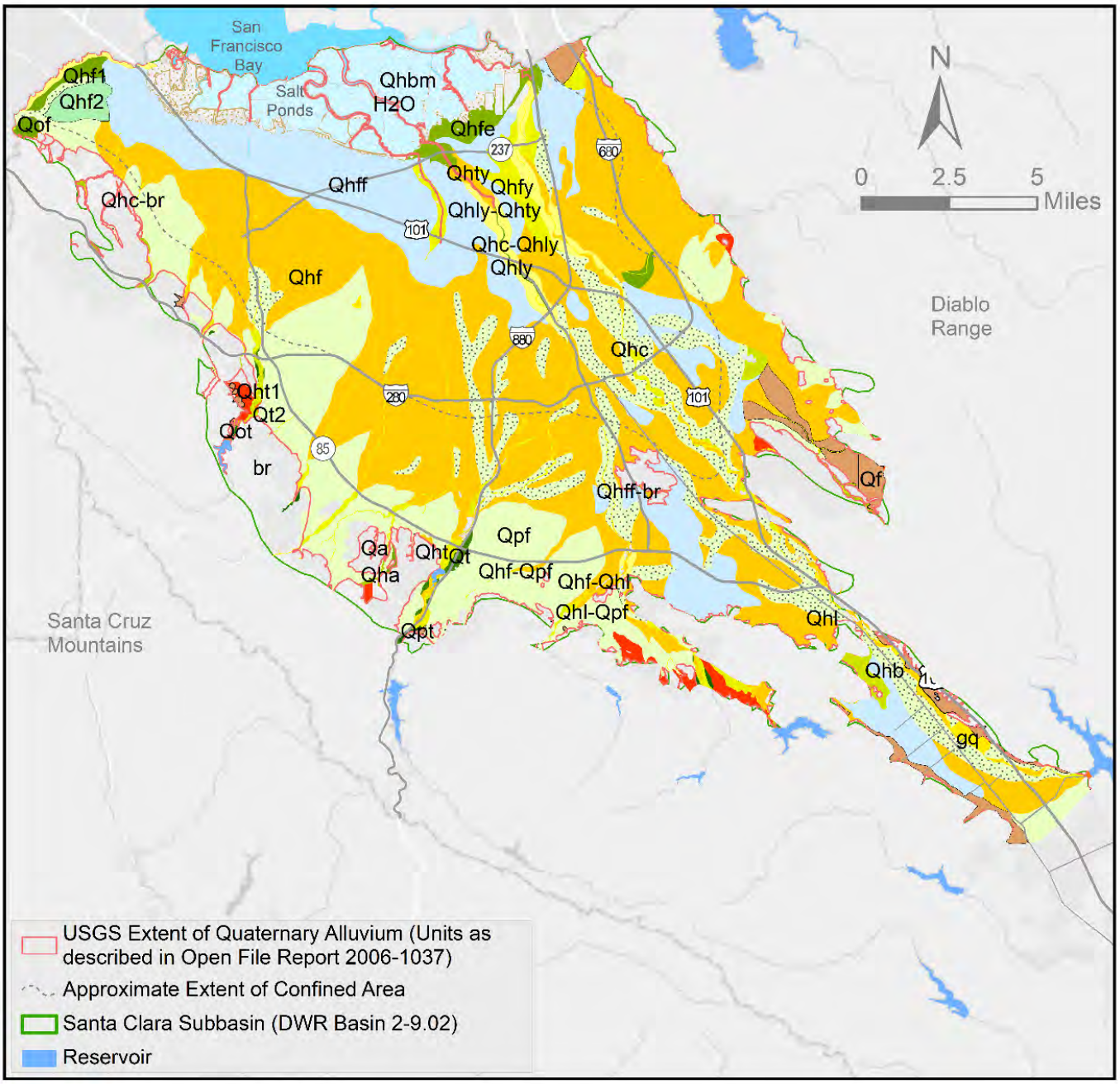

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Figure 2-3. Santa Clara Subbasin Cross-Section Locations

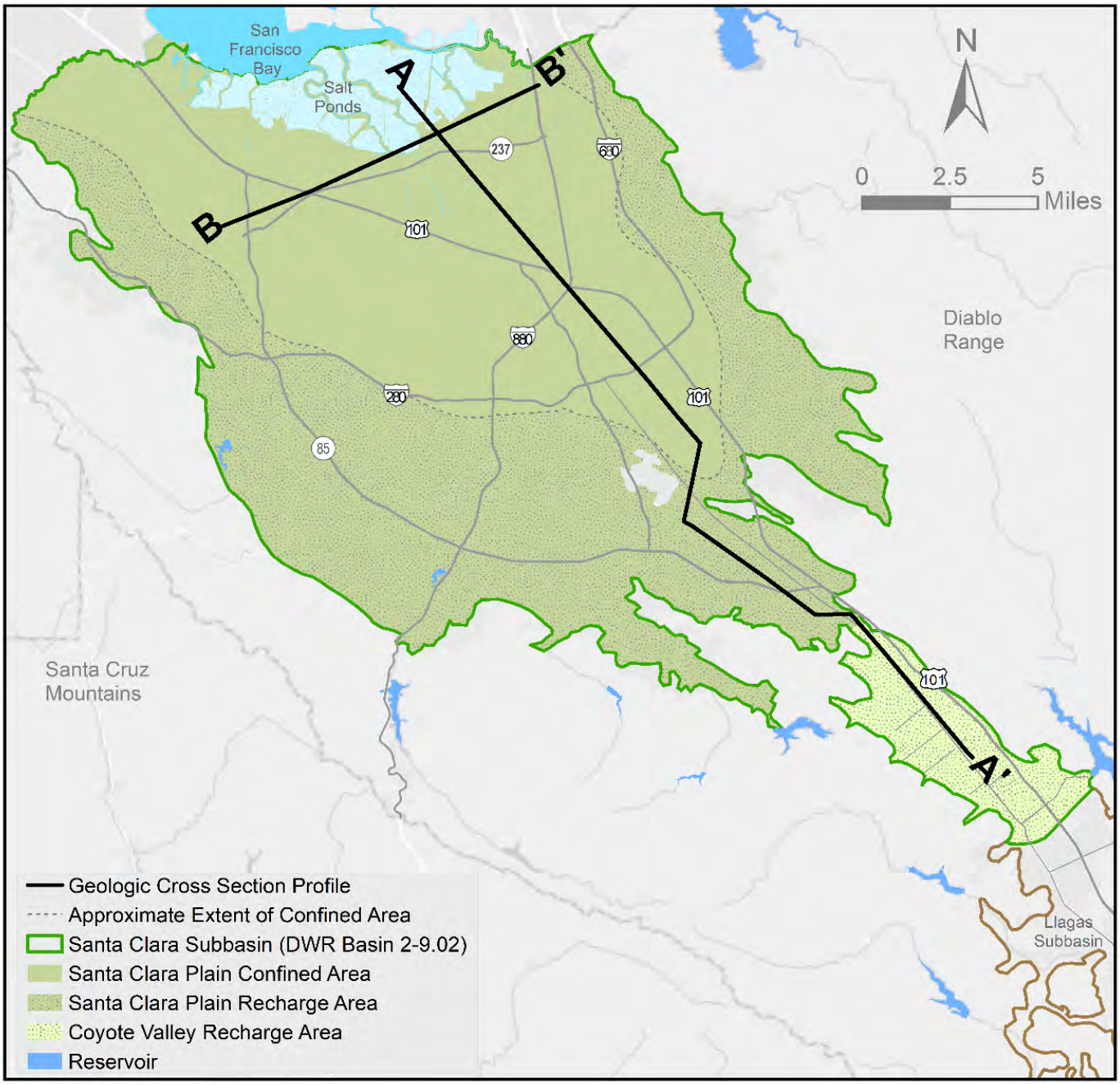

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Figure 2-4. Santa Clara Subbasin Longitudinal Cross-Section

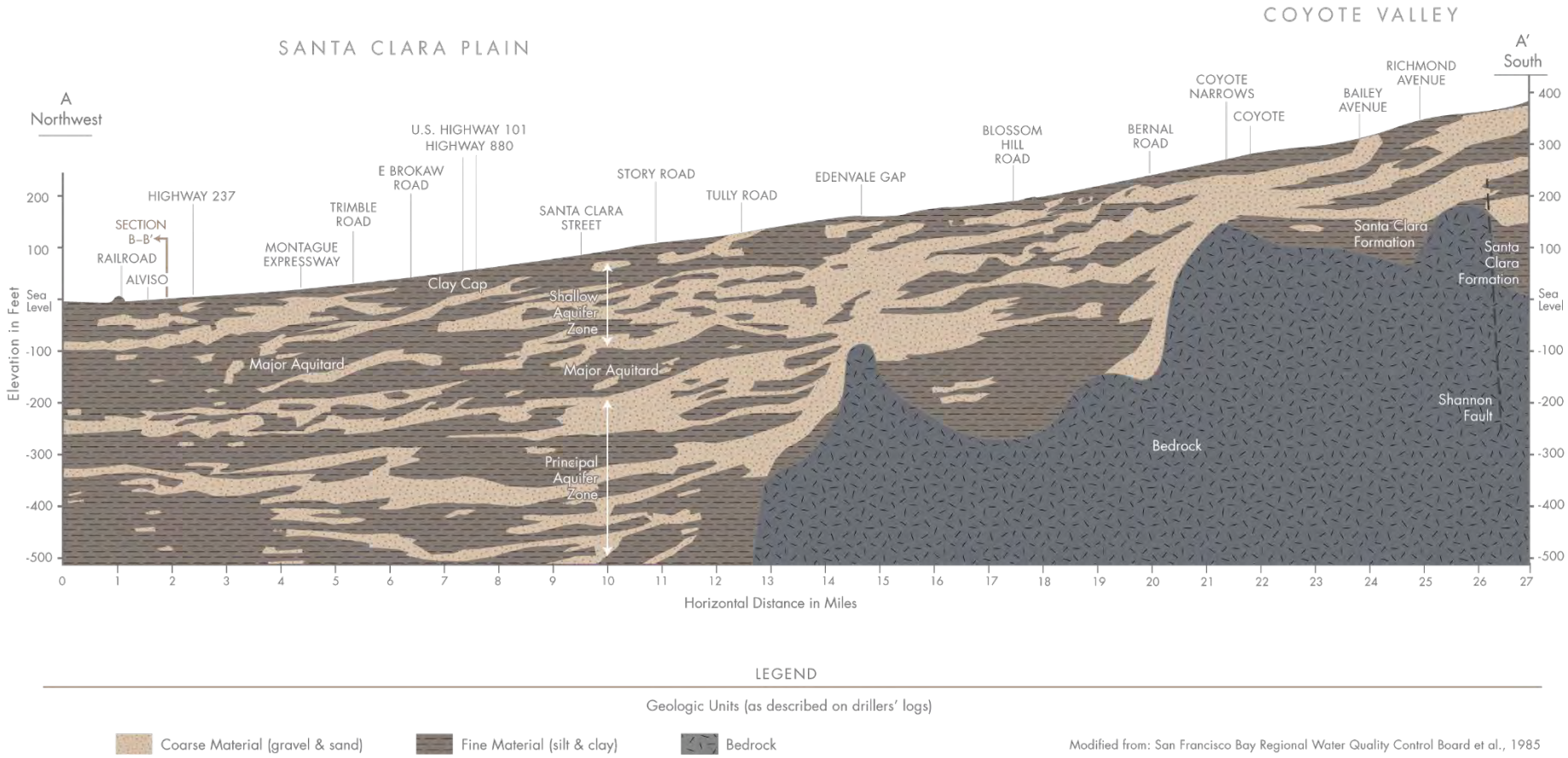
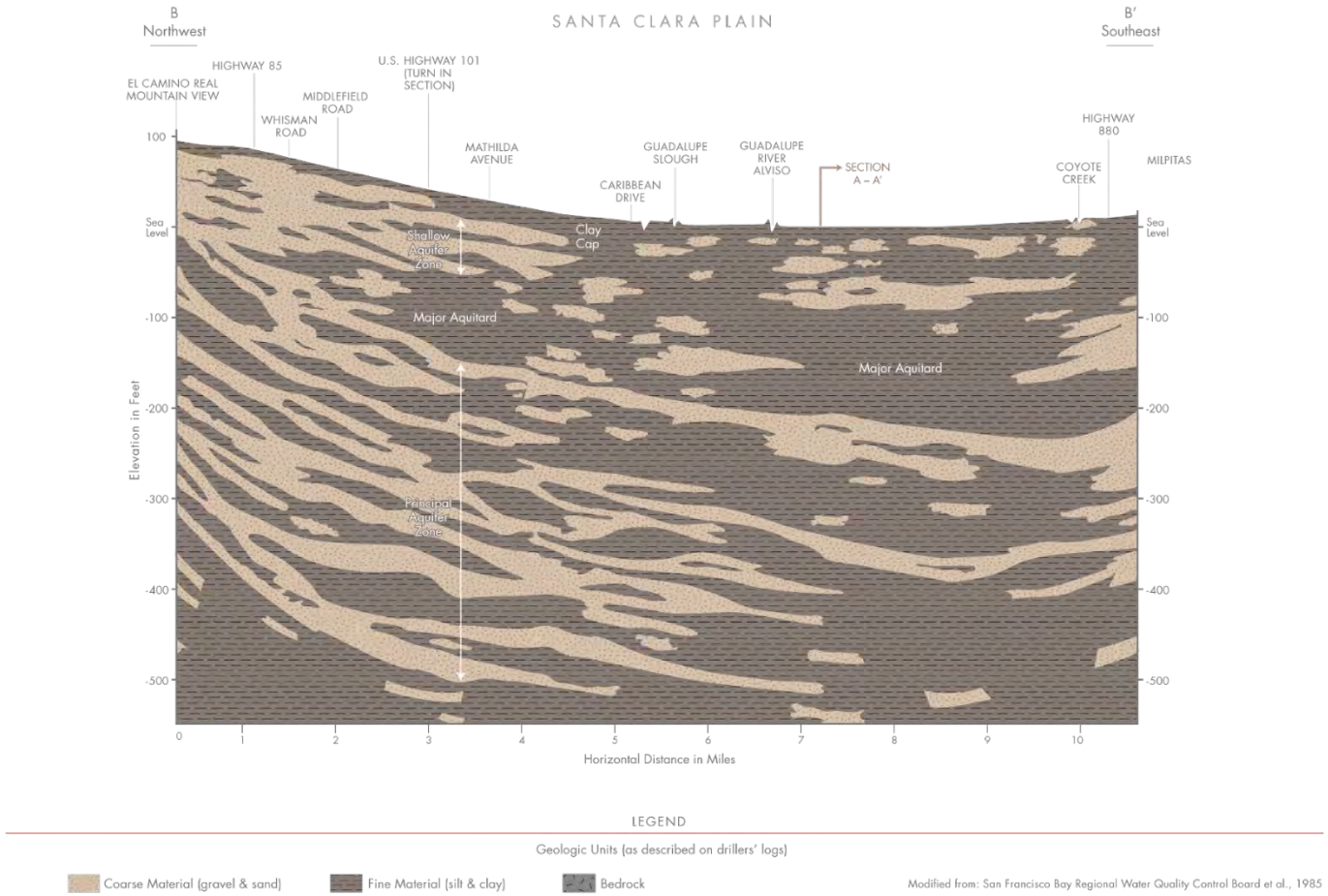


Figure 2-5. Santa Clara Subbasin Transverse Cross-Section

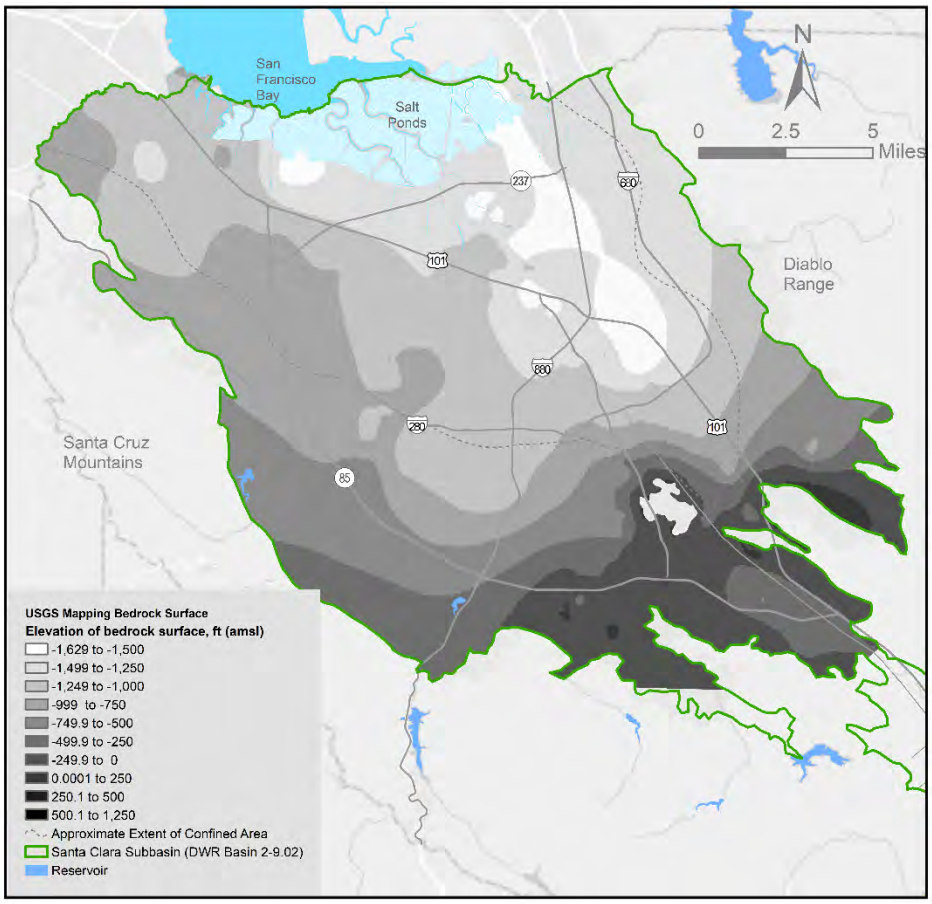


2.1.4 Subbasin Bottom

The bottom of the Santa Clara Subbasin is the contact between the unconsolidated alluvial sediments and impermeable bedrock forming an irregular surface exposed at different depths. It can be difficult to differentiate the underlying Santa Clara Formation (which may be slightly to semi-consolidated) from the overlying unconsolidated alluvial sediments based on driller's logs. Water supply wells completed at greater depths have encountered bedrock. Limited well data indicate the boundary between unconsolidated sediments and bedrock ranges from about 150 to 200 feet near the Coyote Narrows to about 1,500 feet in the interior of the subbasin. This is supported by deep wells constructed by Valley Water and the USGS.[34] A previous study[35] indicates the maximum alluvial thickness is in excess of 1,500 feet, including the Santa Clara Formation. The depth to bedrock decreases towards the western and eastern edges of the subbasin.

A 2015 USGS report[36] presents more detailed bedrock surface information for the Santa Clara Plain (Figure 2-6) based on 26 wells reaching bedrock, seismic reflection profiles, refraction profiles, and the elevation of mapped depositional contacts of alluvium and bedrock.

Figure 2-6. Santa Clara Plain Bedrock Surface

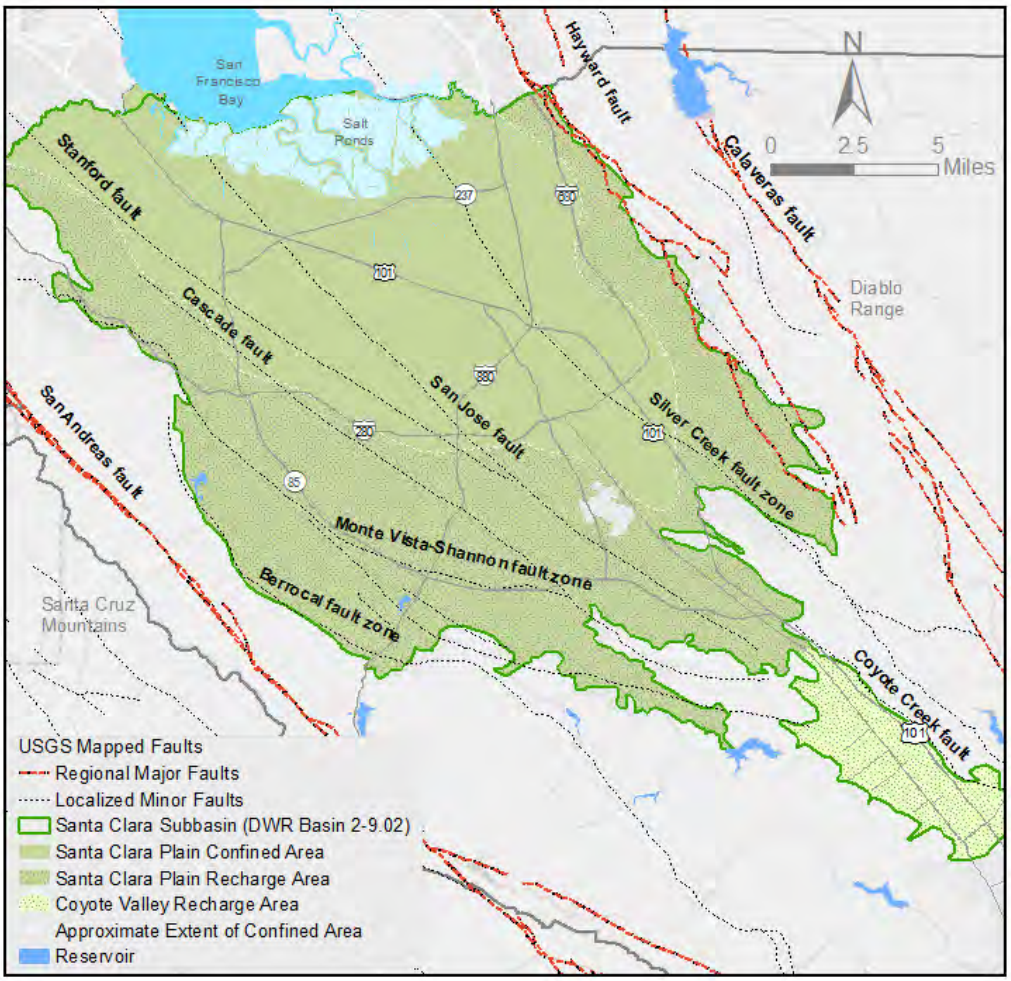


[34] Newhouse et al., Geologic, Water-Chemistry, and Hydrologic Data from Multiple-Well Monitoring Sites and Selected Water-Supply Wells in the Santa Clara Valley, California, 1999–2003, 2004.
[35] Iwamura, Hydrogeology of the Santa Clara and Coyote Valleys Groundwater Basins, California, 1995.
[36] USGS, Physical Subdivision and Description of the Water-Bearing Sediments of the Santa Clara Valley, California, 2015.

2.1.5 Major Faults

The major faults in Santa Clara County are the San Andreas and Hayward/Calaveras faults that helped form the Santa Clara Subbasin by upthrusting adjacent mountains (Figure 2-7). These are right-lateral reverse oblique faults that remain active, creating significant displacement and deformation.[37] Much of the fault network that creates the structural depression in the Franciscan bedrock below the Santa Clara Subbasin is concealed beneath the overlying unconsolidated alluvium.[38] Several secondary faults, including strike slip, oblique and reverse faults are also present. These secondary faults, including but not limited to Silver Creek, San Jose, Stanford, Berrocal Monte-Vista, Shannon, Sargent, and Coyote Creek faults, help accommodate deformation from the major faults.[39] While some studies have suggested that the Silver Creek Fault impedes groundwater flow,[40] a previous study in the area by Iwamura (1995) and observed water level data does not substantiate this fault acting as a groundwater flow barrier (Figure 2-7).

Figure 2-7. Location of Major Fault Systems



[37] Simpson et al., Seismicity and the Major Strike-Slip Faults Bordering the Santa Clara Valley, California, 2005.
[38] Schmidt and Bürgmann, Time-Dependent Land Uplift and Subsidence in the Santa Clara Valley, California, from a Large Interferometric Synthetic Aperture Radar Data Set, 2003.
[39] Simpson et al., Seismicity and the Major Strike-Slip Faults Bordering the Santa Clara Valley, California, 2005.
[40] USGS, Physical Subdivision and Description of the Water-Bearing Sediments of the Santa Clara Valley, California, 2015.

2.2 SUBBASIN CONDITIONS

This section describes Santa Clara Subbasin conditions with regard to groundwater elevations, flow, quality, land subsidence, surface water/groundwater interaction, groundwater dependent ecosystems (GDEs), and seawater intrusion.

2.2.1 Groundwater Elevation and Flow

Groundwater movement in the Santa Clara Subbasin generally follows topographical and surface water patterns, flowing to the north/northwest toward the interior of the subbasin and San Francisco Bay. Groundwater also moves toward areas of intense pumping at the local scale. Groundwater occurs at different depths in the unconfined aquifer throughout the subbasin and under artesian conditions in the Santa Clara Plain confined aquifer.

In the Santa Clara Plain, regional groundwater elevations are typically highest near the margins, with elevations decreasing in the subbasin interior. Several large cones of depression are present within the confined area due to concentrated pumping. Except during periods of extended drought, the vertical gradient is upward in much of the confined area. There is a vertical downward gradient in the recharge area and near the confined area/recharge area boundary. Regional groundwater elevations in the Coyote Valley are typically highest at the groundwater divide near the Llagas Subbasin boundary, with a downward vertical gradient.

The groundwater elevation contour maps depict the groundwater table (or potentiometric surface) for spring 2019 (Figure 2-8) and fall 2019 (Figure 2-9) for the principal aquifer zone of the Santa Clara Subbasin. As indicated by the contour maps, typical seasonal patterns result in higher groundwater elevations in the spring and lower elevations in the fall. Contour maps for 2019 are included since 2019 represents the most recent year where water levels were not significantly affected by the 2012–2016 drought. Groundwater levels displayed typical patterns in 2019, with higher groundwater elevations in the spring as compared to the fall. Groundwater levels are typically lower in the fall because of the lack of precipitation and higher groundwater demand throughout the summer months.

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Figure 2-8. Spring 2019 Principal Aquifer Groundwater Elevation Contours

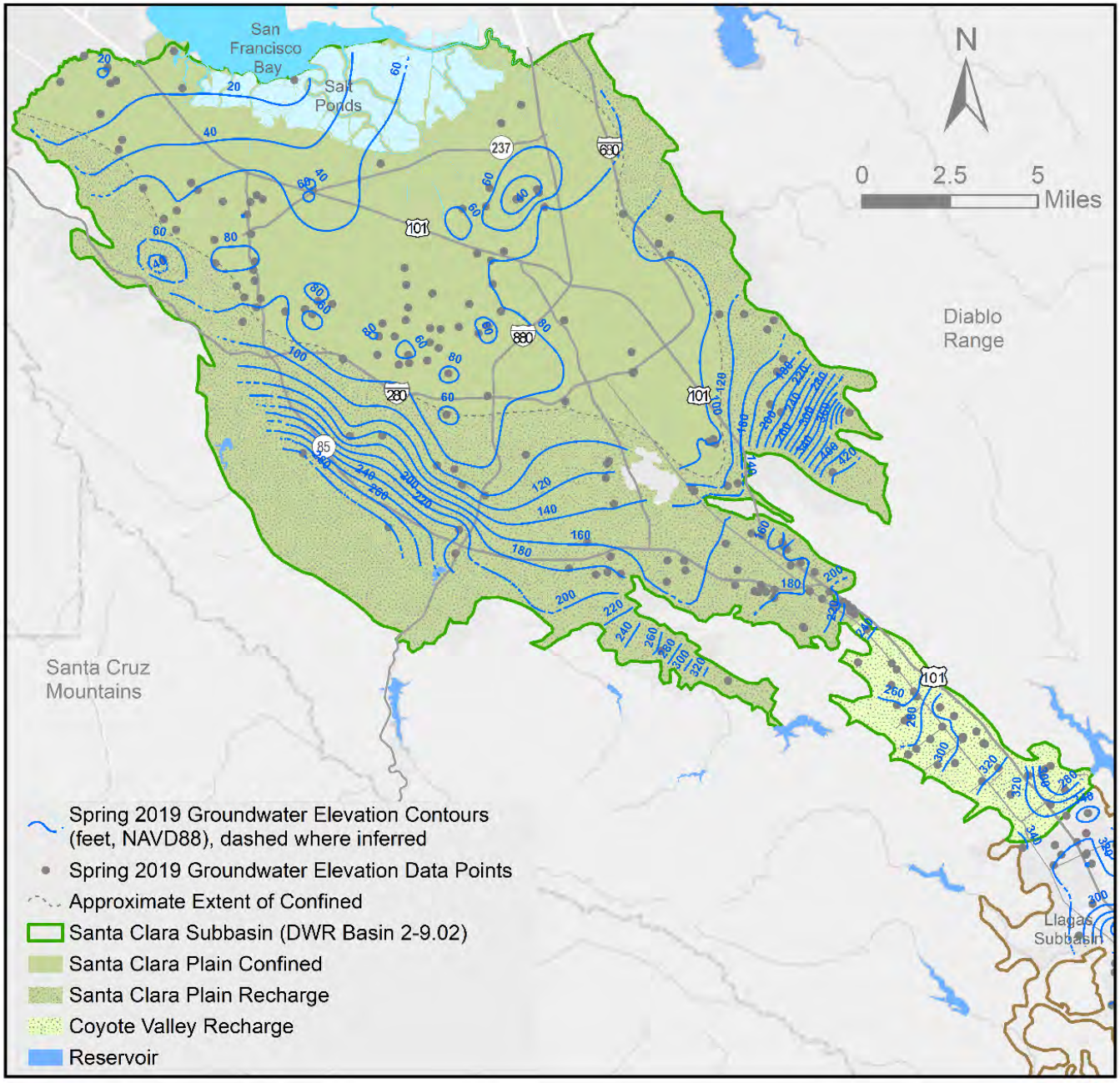
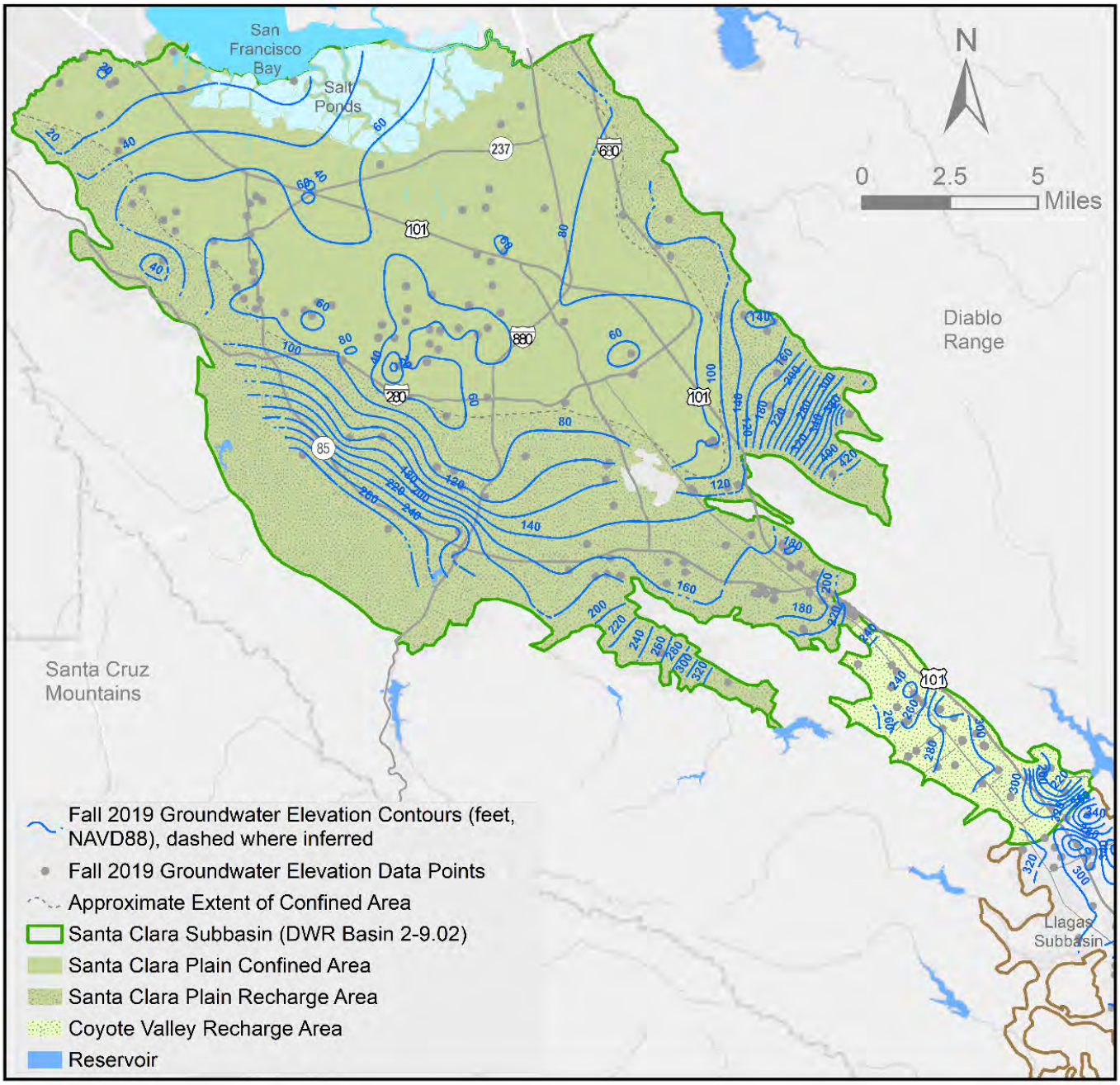
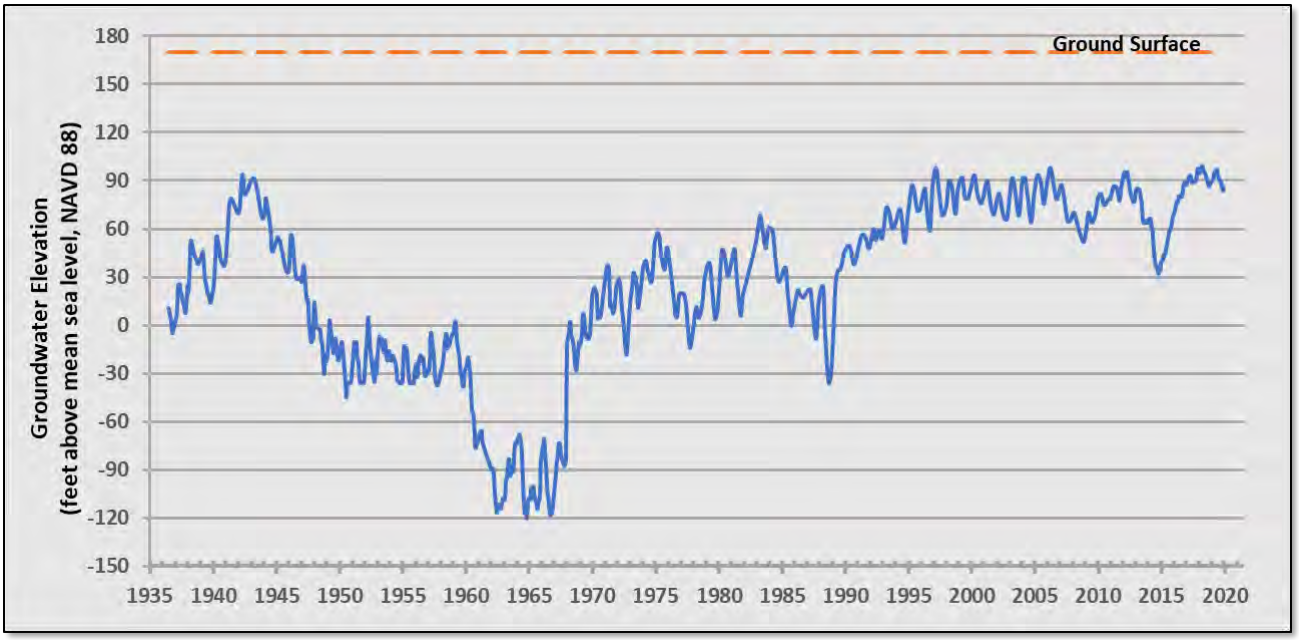


Figure 2-9. Fall 2019 Principal Aquifer Groundwater Elevation Contours



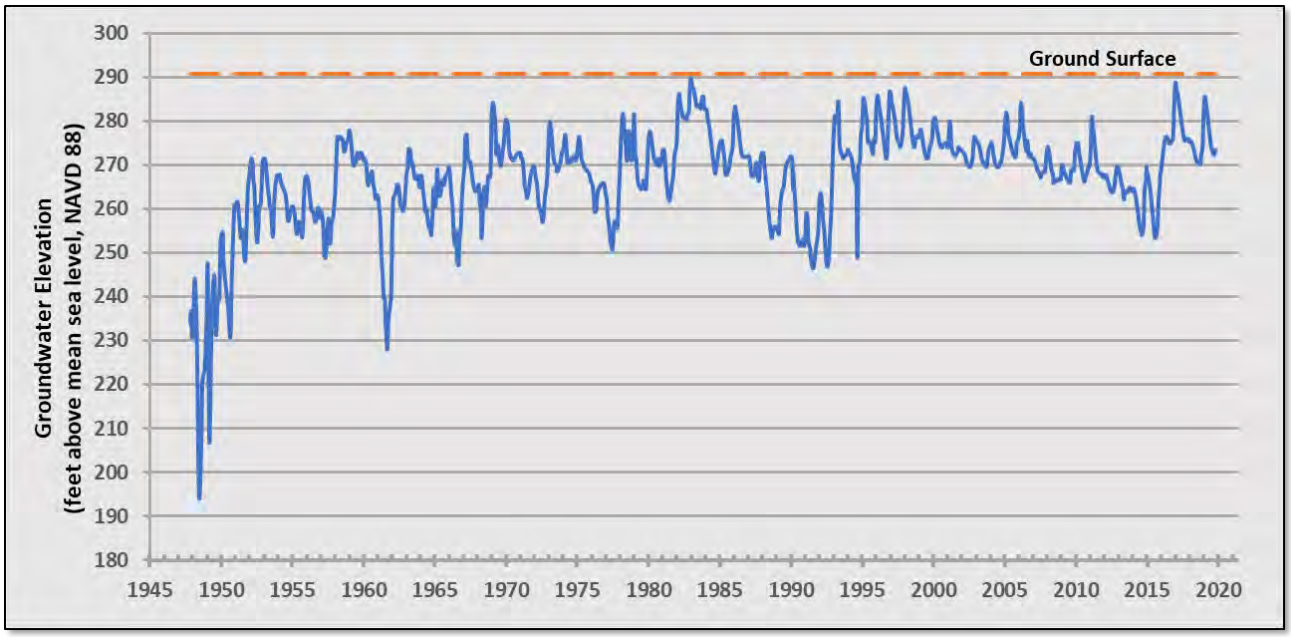
Figures 2-10 and 2-11 are long-term hydrographs for regional index wells in the Santa Clara Plain and Coyote Valley. As indicated on Figure 2-10, there has been a significant rebound in groundwater levels since the mid-1960s due to Valley Water efforts to import water and augment groundwater recharge both directly and through in-lieu recharge such as treated surface deliveries to retailers in lieu of pumping. Additionally, Valley Water's response to the 2012–2016 statewide drought enabled a quick recovery in local groundwater levels (Figure 2-10 and 2-11).

Figure 2-10. Groundwater Elevation in the Santa Clara Plain Regional Index Well (07S01W25L001)



Note: NAVD 88 is the North American Vertical Datum of 1988.

Figure 2-11. Groundwater Elevation in the Coyote Valley Regional Index Well (09S02E02J002)



2.2.2 Land Subsidence

The northern Santa Clara Valley was the first area in the United States where permanent land subsidence due to groundwater withdrawal was recognized.[41] From about 1915 to 1966, groundwater pumping in the Santa Clara Plain increased dramatically due to growing agricultural use and population growth, resulting in a decline of groundwater levels by as much as 200 feet and long-term overdraft. Fluid pressure in the aquifers was reduced, resulting in the dewatering and compression of fine-grained materials (e.g., clays) and a broad sagging of the land surface. Up to about 14 feet of inelastic (permanent) subsidence was observed in San Jose between 1915 and 1969. The land subsided by 3 to 6 feet over a large area encompassing north San Jose, Santa Clara, Sunnyvale, and Mountain View and subsidence of over a foot stretched over 100 square miles. Figure 2-12 shows contours of historical subsidence occurring between 1934 and 1967.

Serious problems developed as a result of subsidence, including flooding of lands adjacent to San Francisco Bay, decreased ability of local streams to carry away winter flood waters and damage to utilities and infrastructure. This necessitated the construction of additional dikes, levees, and flood control facilities to protect properties from flooding. The historic costs of subsidence have been estimated to be more than $756 million in 2013 dollars[42]. This is equivalent to about $947 million in 2021 dollars (escalated based on the U.S. Bureau of Labor Statistic Consumer Price Index for the San Francisco-Oakland-Hayward Metropolitan Statistical Area from 2013 to 2021).

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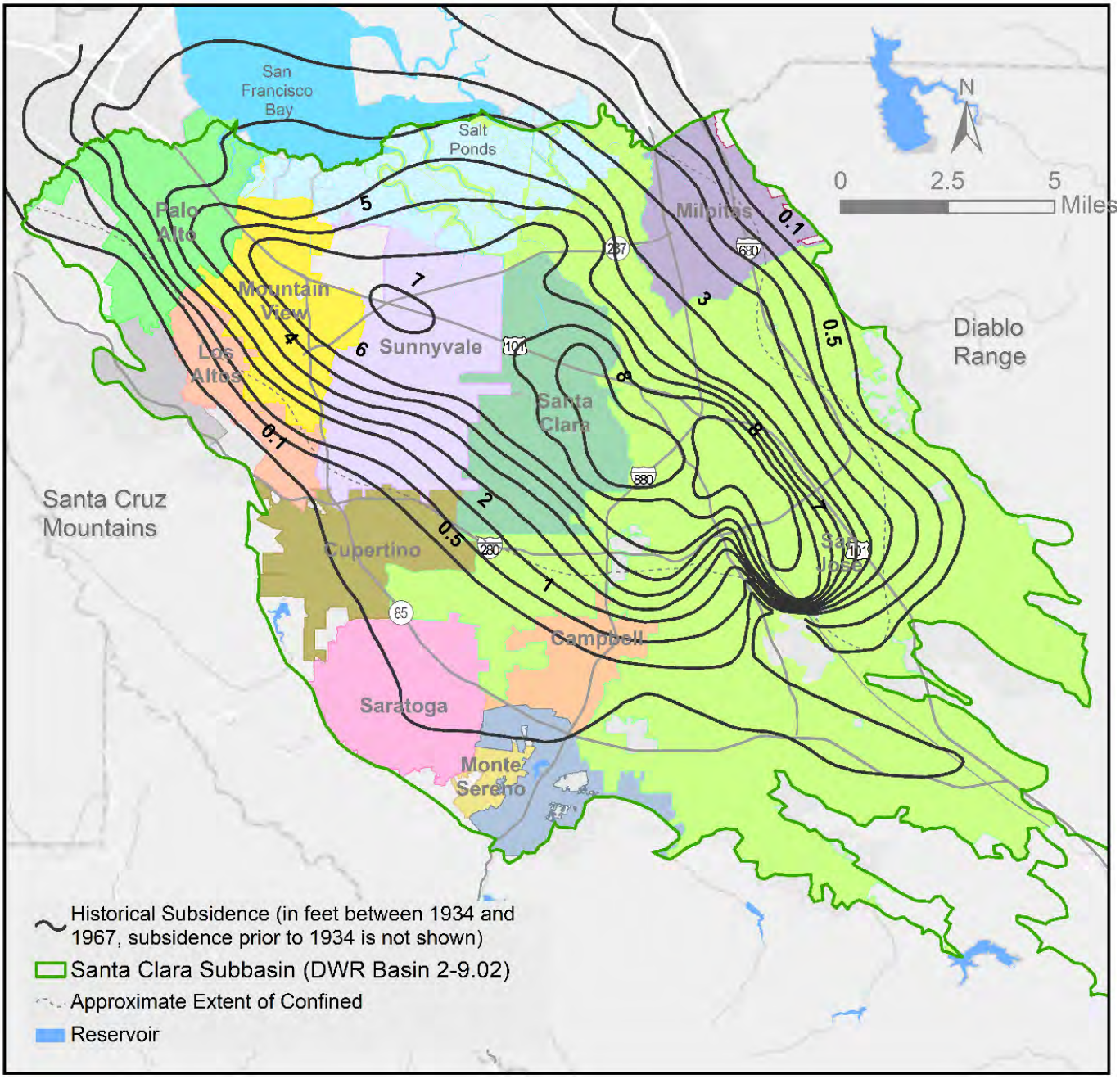
[41] Poland and Ireland, Land Subsidence in the Santa Clara Valley, California, as of 1982,1988.

[42] Borchers, J.W., and Carpenter, M., 2014, Land subsidence from groundwater use in California, Luhdorff & Scalmanini Consulting Engineers, 151 pages.

Figure 2-12. Historical Subsidence in the Santa Clara Plain (1934 to 1967)



Note: historical subsidence contours from Poland and Ireland, 1988, Land Subsidence in the Santa Clara Valley, California, as of 1982, USGS Professional Paper 497-F.

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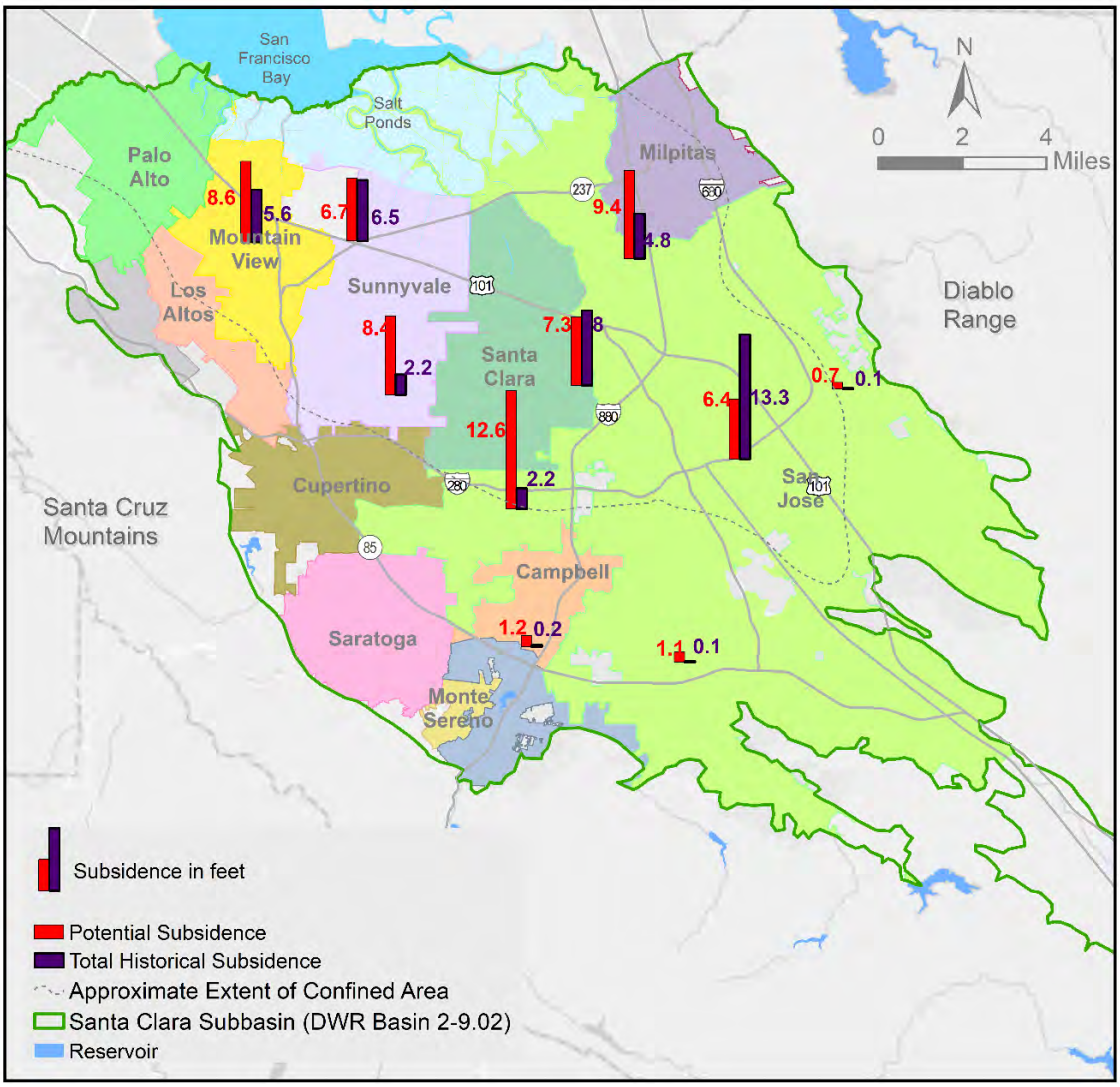
Significant inelastic (permanent) subsidence was essentially halted by about 1970 through Valley Water's expanded conjunctive management programs, which allowed artesian heads to recover substantially. Some amount of elastic subsidence occurs annually in response to seasonal pumping and recharge as indicated by ground surface elevations measured by Valley Water's annual land surface elevation benchmark surveys and with Interferometric Synthetic Aperture Radar (InSAR).[43] Valley Water has established an acceptable subsidence rate of no more than 0.01 feet per year based on multi-year average, which was endorsed by the Water Retailer Groundwater Subcommittee many decades ago. Valley Water has evaluated remaining land subsidence potential under prolonged overdraft conditions, as shown in Figure 2-13, and has established water level thresholds at ten subsidence index wells.[44] These thresholds are the groundwater levels that must be maintained to ensure a low risk of unacceptable land subsidence, as described in Chapter 5.

Figure 2-13. Historical and Potential Subsidence in the Santa Clara Plain

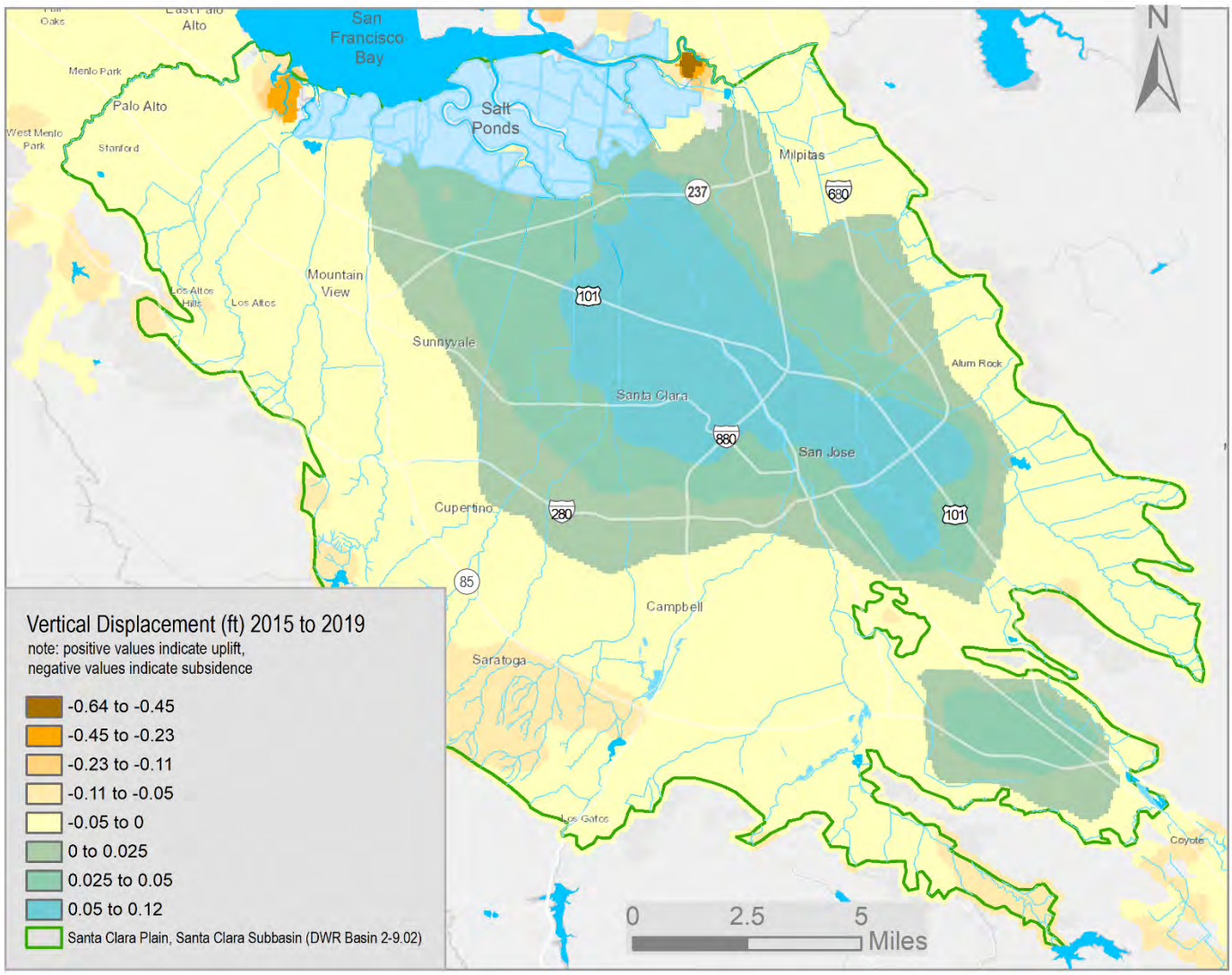


[43] Schmidt and Burgmann, Time-Dependent Land Uplift and Subsidence in the Santa Clara Valley, California from a Large Interferometric Synthetic Aperture Radar Data Set, 2003.

[44] Geoscience Support Services Inc., Subsidence Thresholds in the North County Area of Santa Clara Valley, 1991.

The nature of elastic subsidence and uplift in the Santa Clara Plain is illustrated by annual InSAR data. Figure 2-14 shows vertical ground surface displacement estimates from InSAR data collected from 2015 to 2019 by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA, under contract with DWR as part of DWR's SGMA technical assistance to GSAs[45]. While subsidence was measured by Valley Water's monitoring network during the 2012 to drought, the period from 2015 to 2019 is characterized by recovery of groundwater levels (Figure 2-10) and storage in the Santa Clara Plain, indicating that subsidence that occurred was in the elastic (non-permanent) range. Figure 2-14 indicates as much 0.12 feet of uplift in groundwater surface elevation along the north-south axis of the valley because of increasing groundwater levels and recovery of groundwater storage following the drought. It is important to note that the two localized areas of subsidence on the west and east side of the salt ponds (Figure 2-14) are likely caused by settlement of former and active landfills (Byxbee Park in Palo Alto and Newby Island landfill in San Jose) and not associated with groundwater pumping.

Figure 2-14. Vertical Ground Surface Displacement in the Santa Clara Plain from InSAR Data (2015 to 2019)



[45] https://data.cnra.ca.gov/dataset/tre-altamira-insar-subsidence

Even with the managed recharge of local and imported water, groundwater alone cannot support the Santa Clara Plain, which is a heavily urbanized area. Programs that reduce or offset groundwater pumping (e.g., treated water deliveries, water conservation, and water recycling) are critical to avoid long-term overdraft, additional subsidence, and seawater intrusion. The potential for renewed inelastic subsidence in the Santa Clara Plain is an ongoing concern, and Valley Water carefully monitors and manages water supplies to minimize the risk of permanent subsidence recurring. The Coyote Valley is predominantly composed of coarser-grained materials, and land subsidence has not been observed in the area.

2.2.3 Surface Water and Groundwater Interaction

Valley Water's managed recharge program includes significant recharge through many miles of stream channels over the recharge area, indicating groundwater and surface water generally are disconnected in these reaches. As described further below, the managed recharge program helps to maintain flows in these creeks, most of which would flow only intermittently otherwise. Valley Water is not aware of any areas where groundwater pumping has a significant or unreasonable effect on interconnected surface water.

Valley Water has a comprehensive surface water monitoring network to measure creek flows, comply with water rights reporting and reservoir restrictions, and meet environmental requirements. Stream gauging by Valley Water is discussed in Chapter 7. Surface water flow data can be used to evaluate which stream reaches are gaining or losing with regard to groundwater, as described below.

Figure 2-15 shows areas of known and suspected surface water/groundwater interaction. Identification of these areas is based on long-term observations by Valley Water field staff and supported by a 2018 differential gauging study conducted by Valley Water staff. This differential gauging study compared stream discharge at upstream and downstream gauges during the low flow period of April to July 2018. Downstream gauges with an increase in stream discharge compared to the upstream gauge indicate the reach is in a groundwater discharge area and a gaining stream. Conversely, downstream gauges with a decrease in stream discharge compared to the upstream gauge indicate the reach is in a groundwater recharge area and a losing stream.

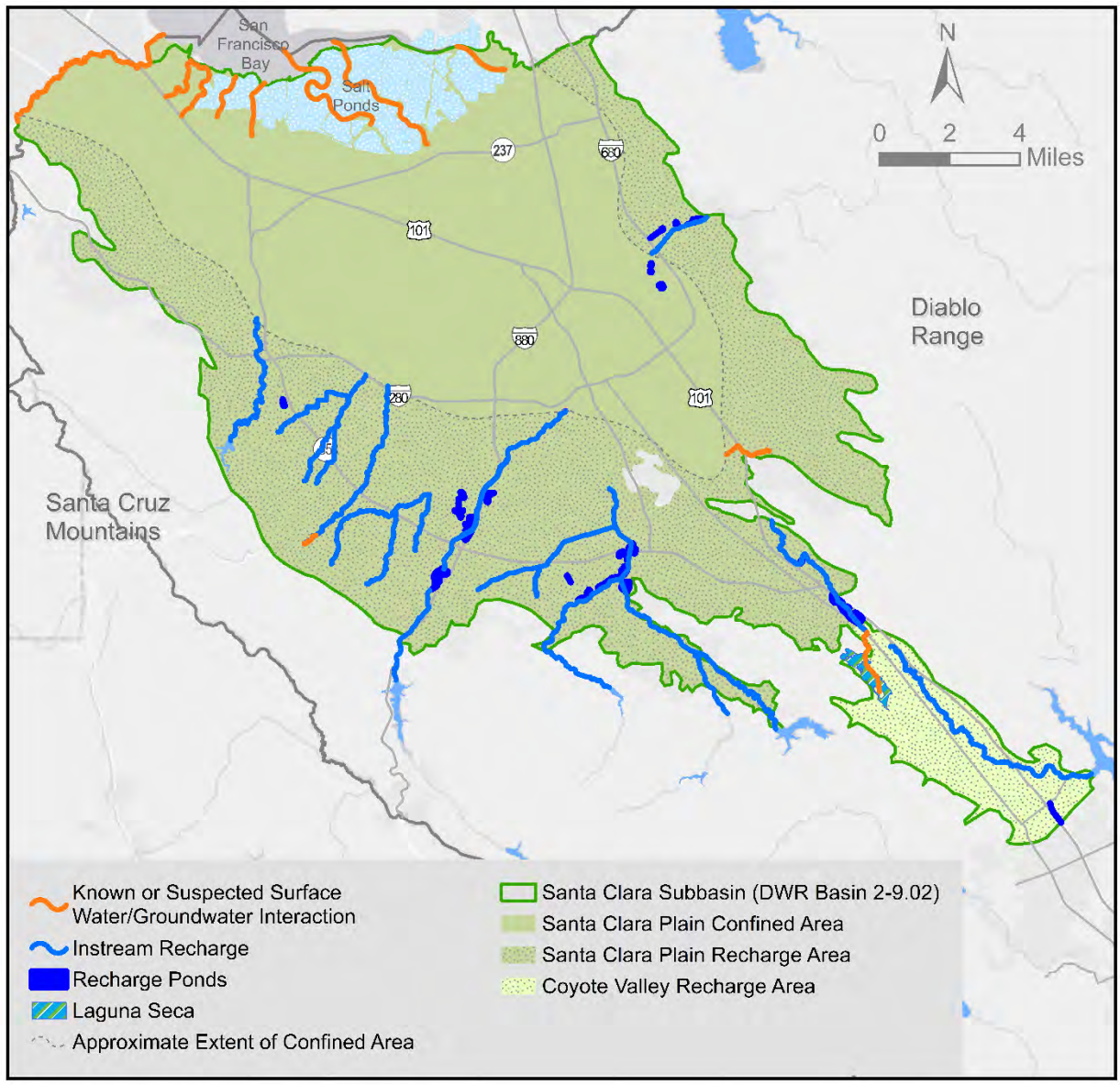
The Santa Clara Subbasin has primarily losing stream reaches that are used in Valley Water's instream managed recharge program where stream water percolates downward through the stream channel and recharges the underlying aquifer (Figure 2-15). Natural streamflow and operational releases from Valley Water's local reservoirs provide nearly perennial flows during most years in many of the losing stream reaches that were historically ephemeral streams prior to Valley Water's operations. Typically, under natural conditions, perennial streams are gaining streams that are supported by baseflow from groundwater discharge, and thus are usually indicative of interconnected surface water and groundwater dependent ecosystems (GDEs). However, Valley Water's reservoir releases have created nearly perennial streams in losing stream reaches that are disconnected from the regional groundwater table, and thus are not likely interconnected surface water or GDEs under SGMA, as described below. Although these areas are net losing reaches, some reaches may intermittently gain during the wet season.[46] Appendix G provides a more detailed discussed of surface water and groundwater interaction in the context of GDEs.

The natural stream flow in these losing stream reaches is enhanced through Valley Water's release of local and imported water. Although many of these creeks were normally dry during the summer, Valley Water's recharge program has resulted in extending the period of flow in the creeks. For example, data from the Coyote Creek Edenvale gauge (station number 5058), before and after the construction of Anderson Dam indicates that prior to the dam's construction, there was no flow observed a majority of the time from May to November. After reservoir

[46] Hanson, Hydrologic Framework of the Santa Clara Valley, 2015.

construction, flow was observed a majority of the time during the same months. Also, the number of months where daily flow was observed in Coyote Creek increased post-construction. This indicates that stream flows have increased due to Valley Water reservoir operations.

Figure 2-15. Santa Clara Subbasin Surface Water/Groundwater Interaction



Gaining reaches in the Santa Clara Subbasin are primarily located in sections of the creeks overlying the confined area of the subbasin closer to San Francisco Bay (Figure 2-15). Exceptions to this are:

- San Francisquito Creek (northern Santa Clara Plain): Metzger (2002) studied San Francisquito Creek stream flow gains and losses between April 1996 and May 1997.[47] Stream flow losses were greatest in the reach from Sand Hill Road to Middlefield Road where the creek is underlain by coarse alluvium. Downstream of Middlefield

[47] Metzger, Streamflow Gains and Losses along San Francisquito Creek and Characterization of Surface-Water and Ground-Water Quality, Southern San Mateo and Northern Santa Clara Counties, California, 2002.

Road, tidal effects and storm drain discharges made it difficult to quantify gains and losses. Groundwater hydrographs indicate the water table may intersect the stream bed in this reach, particularly in the winter and spring months. San Francisquito Creek was losing from Woodland Avenue to Newell Road. Downstream of Newell Road was gaining, but the source of the water could not be determined due to storm drain discharge and tidal influence. The average annual streamflow loss from San Francisquito Creek was estimated at 1,050 AF per year.

- Lower Silver Creek (eastern Santa Clara Plain): Valley Water field staff have identified a portion of Lower Silver Creek where groundwater discharges into surface water based on field observations.
- Saratoga Creek (western Santa Clara Plain): Tetrachloroethene (released into groundwater from a dry-cleaning facility) has been detected in Saratoga Creek near downtown Saratoga near the subbasin's western margin. This indicates that groundwater is seeping into the creek at least intermittently.
- Fisher Creek (western Coyote Valley): Surface water in Coyote Creek recharges groundwater along the southern and east sides of the Coyote Valley. Groundwater in the area generally flows towards the northwest, where it rises and discharges into Fisher Creek due to the complex geologic and hydrogeologic conditions of the area.
- Laguna Seca Area (northwestern Coyote Valley): Laguna Seca is intermittent wetland caused by a combination of shallow groundwater and flooding. Iwamura[48] (1995) states that the Laguna Seca area, before the installation of an artificial drain, was part of the historical swampy or marshy area due to groundwater discharge to the surface and overflowed into Coyote Creek.

The historical ecology (Figure 2-16) and the depth to groundwater[49] (Figure 2-17) of the Santa Clara Subbasin can help evaluate surface water/groundwater interaction. Figure 2-16 presents historical ecology mapping developed by the San Francisco Estuary Institute (SFEI), which maps areas such as wetlands, marshes, and willow groves that may be associated with shallow groundwater. [50,51] Some of the wetland areas may have been present due to poorly draining soils rather than surface water/groundwater interaction. It is also important to note that this was the historical distribution circa the early 1800s, prior to development and does not represent current or even recent conditions. This figure also indicates that, historically, the Guadalupe River was the only perennial stream in the Santa Clara Subbasin. The other creeks were intermittent, running during the wet season, but dry in the summers.

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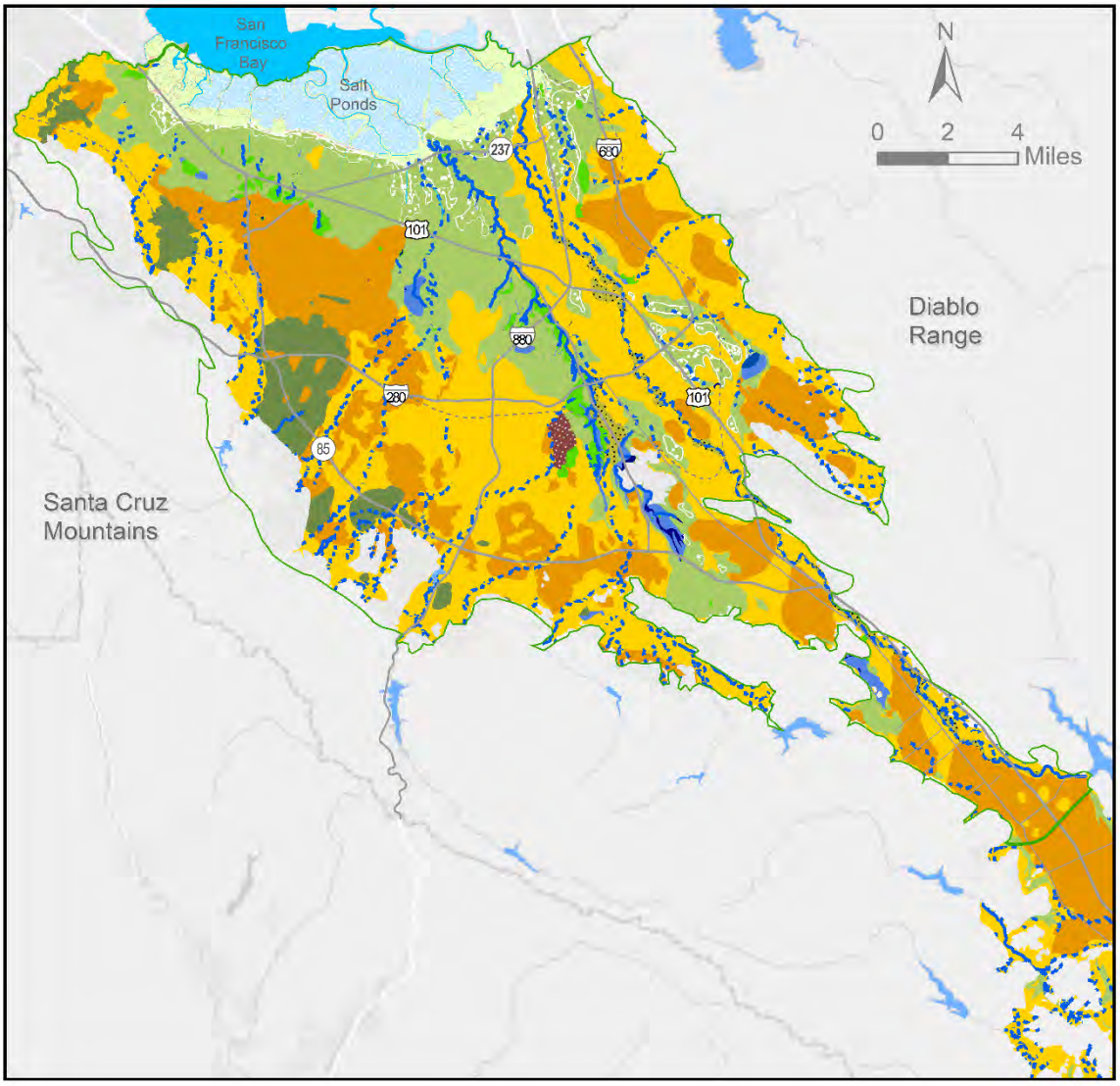
[48] Iwamura Hydrogeology of the Santa Clara and Coyote Valleys Groundwater Basins, California, 1995.
[49] SCVWD, GIS Coverage of Depth to First Groundwater, 2021.
[50] Beller, et al., Historical Vegetation and Drainage Patterns of Western Santa Clara Valley: A technical memorandum describing landscape ecology in Lower Peninsula, West Valley, and Guadalupe Watershed Management Areas, 2010.
[51] Grossinger, et al., Coyote Creek Watershed Historical Ecology Study: Historical Condition, Landscape Change, and Restoration Potential in the Eastern Santa Clara Valley, California, 2006.

Figure 2-16. Santa Clara Subbasin Historical Ecology

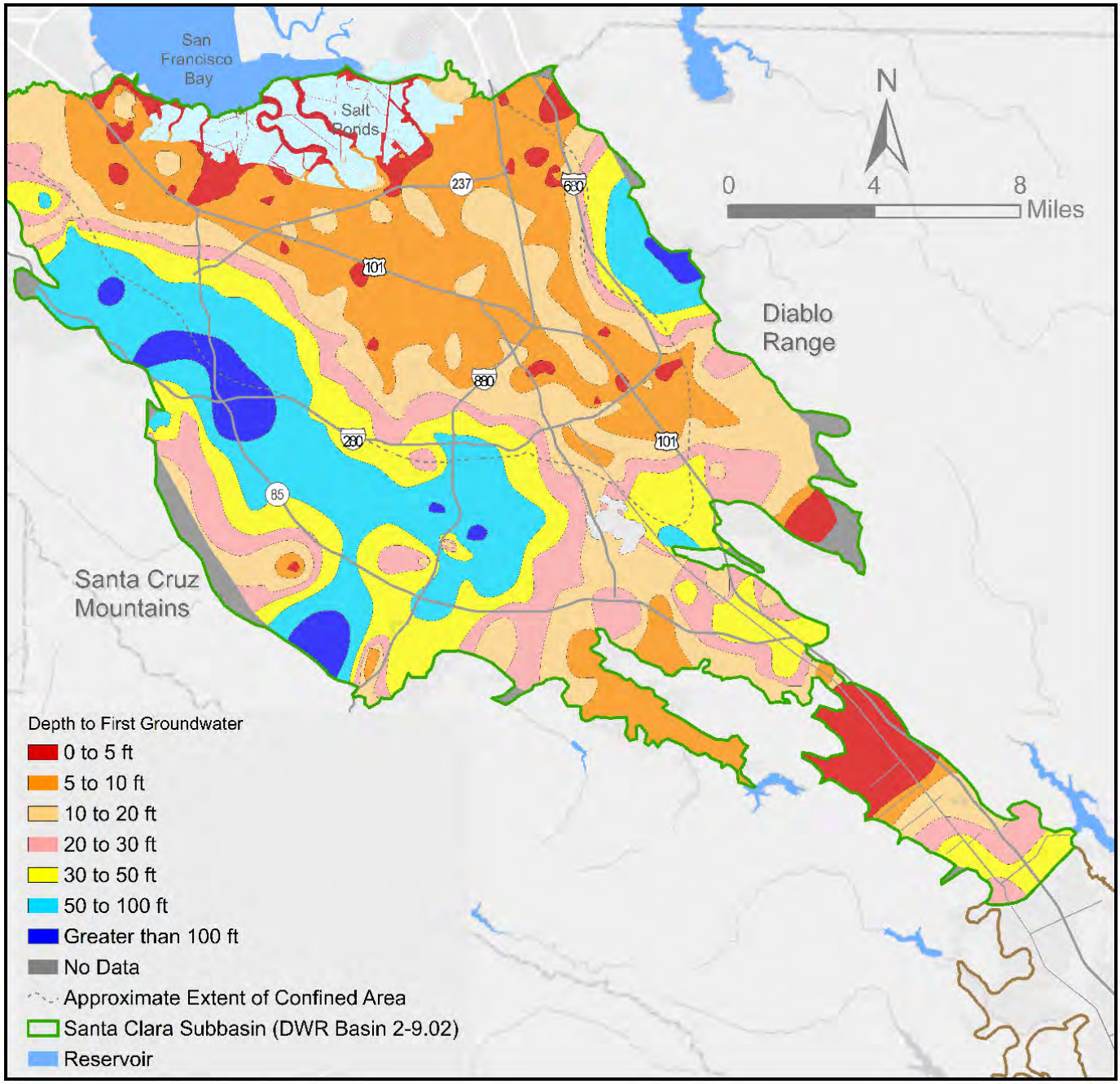


Intermittent Creek
Perennial Creek
Alkali Meadow (high concentration)
Alkali Meadow (low concentration)
Box Elder Grove
Chaparral
Deep Bay
Floodplain Slough
Oak Savanna / Grassland
Oak Woodland
Perennial Freshwater Pond
Salt Flat / Salina
Coyote Riparian: Bar with Riparian Woodland
Coyote Riparian: Island with Riparian Woodland
Coyote Riparian: Low Flow Channel
Seasonal Lake / Pond
Shallow Bay
Shallow Tidal Channel
Sycamore Grove
Tidal Flat / Channel
Tidal Marsh
Tidal Marsh Panne
Wet Meadow
Willow Grove
Wild Rose Thicket
Valley Freshwater Marsh
Santa Clara Subbasin (DWR Basin 2-9.02)
Approximate Extent of Confined Area
Reservoir

Source: San Francisco Estuary Institute, 2015

Figure 2-17 is a generalized depth to first groundwater map based primarily on data from contaminant release sites. This map reflects the shallowest groundwater encountered based on available historical water level data from 1978 to 2019, rather than a specific point in time. The data was compiled from the State Water Resources Control Board GeoTracker database and from Valley Water's monitoring programs. Areas exhibiting shallow groundwater would be more likely to have surface water/groundwater interaction and gaining stream reaches.

Figure 2-17. Depth to First Groundwater in the Santa Clara Subbasin



2.2.4 Groundwater Dependent Ecosystems

The 2021 GWMP includes maps identifying groundwater dependent ecosystems (GDEs). The identification of GDEs is one of five recommended actions by DWR in their review and approval of the 2016 GWMP as an Alternative Plan (Appendix C). Under SGMA, GDEs are "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351(m)). GDEs in California include a wide range of natural communities, including wetlands, rivers, streams, and estuaries, seeps and springs, and terrestrial vegetation. GDEs also include deep-rooted plants or plant communities that obtain water from the water table (called phreatophytes). A detailed technical memorandum that documents the current understanding, approach, and methods used to identify and map GDEs is included in Appendix G.

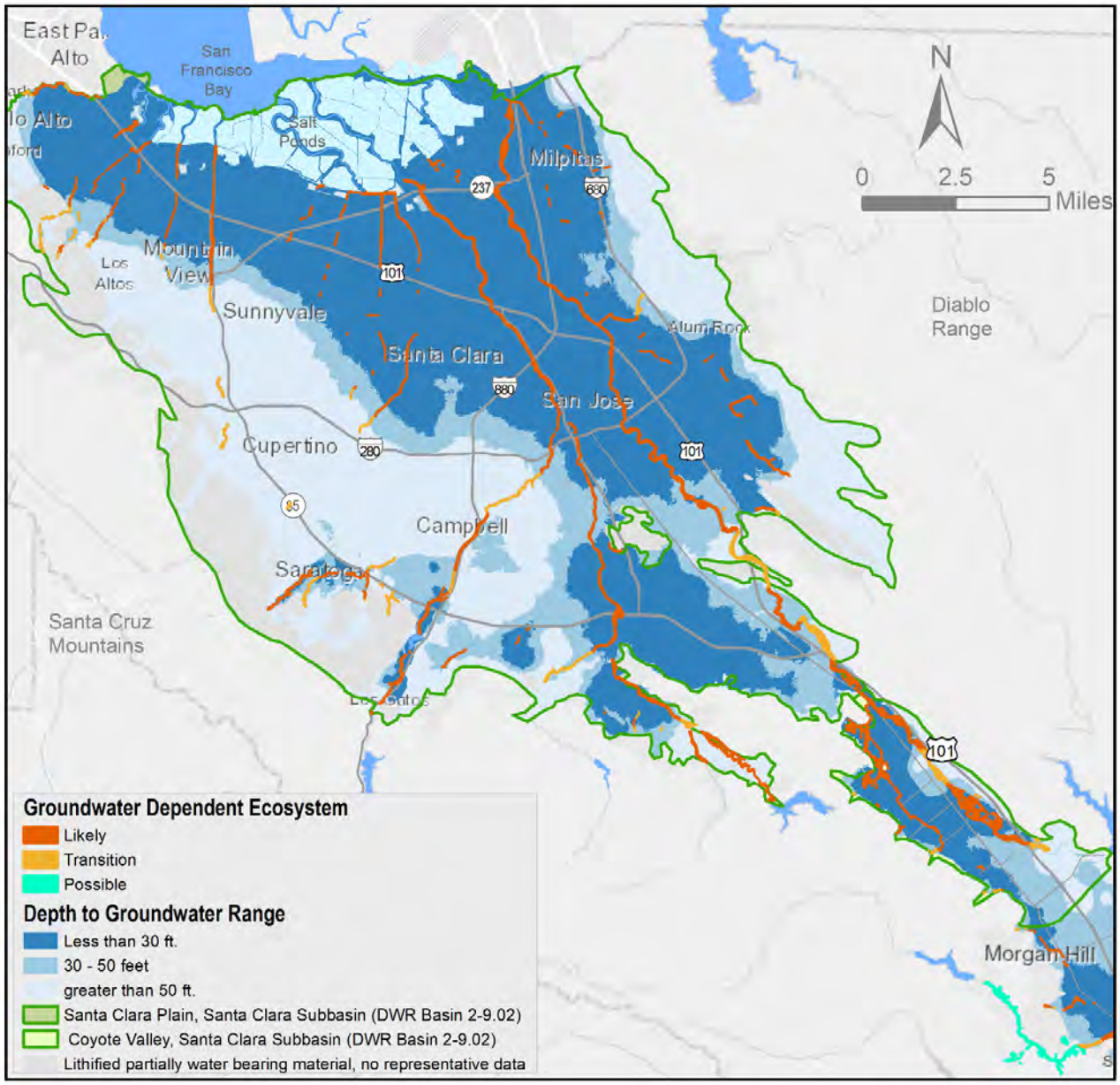
GDEs in the Santa Clara Subbasin are shown in Figure 2-18. This map was created by generally following The Nature Conservancy GDE guidance document[52]. Figure 2-18 is based on all California phreatophytes and identifies GDEs as likely (depth to water (DTW) less than 30 feet), transition (DTW 30 to 50 feet), and possible (DTW unknown). The DTW shown in Figure 2-18 was created using the median water level data between 2010 and 2019 from 454 wells in the Santa Clara Subbasin and a 30 ft LIDAR land surface elevation dataset. It is important to note that the large scale DTW map in Figure 2-18 appears to incorrectly identify some GDEs based on DTW. However, at a zoomed-in map scale, all GDEs are correctly mapped based on DTW categories, as explained in Appendix G. Appendix G also presents the results of 34 field assessments performed by Valley Water biologists and describes how those results were extrapolated and used with the detailed DTW map to delineate GDEs. The GDE maps presented in the 2021 GWMP will be revised and updated as new information becomes available during each five-year Alternative Plan update cycle.

Figure 2-18 indicates that most of the GDEs in the Santa Clara Subbasin are located along stream reaches and in known wetlands, such as the Laguna Seca area of northern Coyote Valley. Most of these stream reaches are losing reaches (Figure 2-15) and are actively used in Valley Water's managed in-stream recharge operations. These recharge operations rely on natural streamflow and operational releases from Valley Water's 10 local reservoirs and imported water pipelines. These releases provide nearly perennial flows during many years in losing stream reaches that were historically ephemeral (intermittent) streams (Figure 2-16) prior to Valley Water's operations. The reservoir releases have created nearly perennial flow in losing streams that are disconnected from the regional water table, and thus are not interconnected surface water or GDEs. Figure 2-18 does not include phreatophytes overlying DTW greater than 50 feet because the DTW exceeds rooting depths. Many reaches downstream of reservoirs overlie likely and transition DTW categories and contain GDEs that are supported by both surface water augmented flows and groundwater. Therefore, some GDEs in Figure 2-18 are supported solely by groundwater and others are supported by a combination of surface water and groundwater. Because indicator phreatophytes are essentially identical along these reaches, it is very difficult to distinguish between the GDEs that are support by groundwater only and those supported by a combination of surface water and groundwater.

Table 2-1 summarizes the area of GDEs in each groundwater management area of the Santa Clara Subbasins. The Santa Clara Subbasin has a total of 4,217 acres of GDEs, including 3,303 acres in the Santa Clara Plain and 914 acres in the Coyote Valley. The Coyote Valley has a relatively large density of GDE area, given the management area's smaller overall area compared to the Santa Clara Plain. The Santa Clara Plain has a relatively greater area of transition GDE category because of the relatively large DTW in many parts of the Santa Clara Plain.

[52] Rohde, M. M., S. Matsumoto, J. Howard, S. Liu, L. Riege, and E. J. Remson. 2018. Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans. The Nature Conservancy, San Francisco, California, 93 pages, available here: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_1-31-18.pdf

Figure 2-18. Groundwater Dependent Ecosystems in the Santa Clara Subbasin



As explained in Chapter 4, the Santa Clara Subbasin has sustainable groundwater supply conditions. Many of the GDEs in the Santa Clara Subbasin (Figure 2-18) overlie the confined area of the Santa Clara Plain where most groundwater supply wells are screened in the principal aquifer zone. In the confined area, the principal and shallow aquifer zones are separated by the regional aquitard (Figure 2-4 and 2-5). Therefore, groundwater pumping from the principal aquifer in the confined area of the Santa Clara Plain is disconnected from the shallow aquifer zone and does not affect GDEs. As explained above and in Appendix G, most GDEs in the recharge (unconfined) areas of the Santa Clara Plain and Coyote Valley are along losing stream reaches that are disconnected from the regional water table and thus are not interconnected surface water. Because these losing stream reaches are not interconnected surface water and streamflow is supported by natural runoff and in-stream recharge operations, GDEs are not affected by groundwater

pumping in these recharge areas of the Santa Clara Plain and Coyote Valley. The Laguna Seca is an area of known wetlands in northern Coyote Valley that has several GDEs, as detailed in Appendix G. Valley Water's groundwater management activities, including managed recharge operations in Coyote Valley have maintained sustainable groundwater supply conditions in the northern Coyote Valley that support GDEs in Laguna Seca. Long-term groundwater levels are stable in Laguna Seca and demonstrate sustainable groundwater conditions in northern Coyote Valley. Droughts of limited duration may suppress the shallow water table, but effects to GDEs are expected to be minimal with continued management activities. Subsequent chapters of the GWMP describe Valley Water's extensive groundwater monitoring networks and comprehensive groundwater management activities that will continue to ensure groundwater sustainability in the Santa Clara Subbasin that help support GDEs.

Table 2-1. Groundwater Dependent Ecosystem Area in the Santa Clara Subbasin

GDE category	Santa Clara Subbasin		Total (acres)
	Santa Clara Plain (acres)	Coyote Valley (acres)	
Likely GDE	2,682	744	3,426
Transition	621	170	791
Possible GDE	0	0	0
Total (acres)	**3,303**	**914**	**4,217**

2.2.5 Groundwater Quality

Valley Water has monitored and evaluated groundwater quality in the Santa Clara Subbasin for decades, with regular testing since the mid-1980s. Water quality data presented and summarized in this section represents data from the last ten-year period (2010–2019) collected by Valley Water and other agencies. The primary source for data collected by other agencies is compliance sampling for public water supply wells submitted by water retailers to the State Division of Drinking Water (DDW). Valley Water's groundwater monitoring and evaluation allows for an appraisal of current conditions and offers a consistent basis for detecting near-term and long-term trends. The Santa Clara Subbasin generally produces groundwater of good quality that does not need treatment beyond disinfection. Groundwater quality data for the Santa Clara Plain and Coyote Valley groundwater management areas are discussed separately, below.

2.2.5.1 Santa Clara Plain

Groundwater in the Santa Clara Plain is typically of very good quality, with infrequent detections of water-quality parameters above health-based Maximum Contaminant Levels (MCLs) (Figure 2-19). Figures 2-20 and 2-21 show the relative concentrations of inorganic parameters, including those with health-based MCLs and aesthetic-based secondary MCLs (SMCLs) [53] for the period 2010 to 2019 in the principal aquifer. This appraisal is based on 10 years of compiled data consisting of Valley Water monitoring data and water quality data acquired from the DDW. Calcium, magnesium, and bicarbonate are the dominant dissolved parameters in the Santa Clara Plain. Variation from this includes groundwater with sodium bicarbonate, sodium chloride, and mixed cation-mixed anion character.

[53] Maximum Contaminant Levels (MCLs) are health-based drinking water standards established by the California Division of Drinking Water or U.S. Environmental Protection Agency. Secondary MCLs are aesthetic-based standards established by these agencies to address aesthetic issues such as taste and odor. Figures 2-18 and 2-19 show only those inorganic parameters detected in moderate or high concentrations relative to the MCL or SMCL.

The 2019 median TDS concentration in the principal aquifer zone was 410 milligrams per liter (mg/L)[54]. TDS occurs at higher concentrations at depth in some localized areas including Evergreen (southeast San Jose) and Palo Alto.

Some areas in the shallow aquifers adjacent to salt ponds and tidal creeks near San Francisco Bay have been affected by seawater intrusion, as indicated by higher chloride and other indicators in some shallow monitoring wells. This condition is discussed more in section 2.2.6.

Summary statistics for the Santa Clara Plain shallow and principal aquifer zones between 2010 and 2019 are presented in Tables 2-2 through 2-5, respectively. Tables 2-2 and 2-3 present summary statistics for all inorganic water-quality parameters. Tables 2-4 and 2-5 present the organic chemicals detected in the shallow and principal aquifers, respectively. Although some organic chemicals are detected in the Santa Clara Plain, detections are infrequent and are typically low concentrations.[55]

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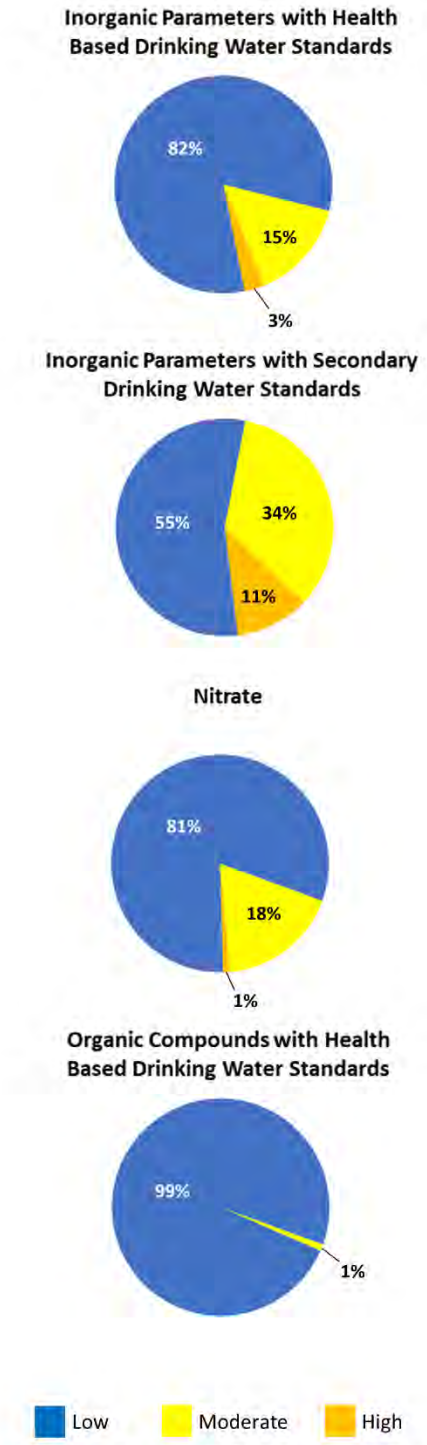
[54] Valley Water, Annual Groundwater Report 2019

[55] Lawrence Livermore National Laboratory, California Aquifer Susceptibility, A Contamination Vulnerability Assessment for the Santa Clara and San Mateo County Groundwater Basins, 2004.

Figure 2-19. Santa Clara Plain Principal Aquifer Water Quality Overview (2010–2019)



High: greater than the MCL, SMCL, or upper SMCL threshold
Moderate: greater than 1/2 the MCL or SMCL, or above the recommended SMCL threshold
Low: not detected, less than 1/2 the MCL or SMCL, or below the recommended SMCL threshold
Based on the most recent data from 2010-2019.

Inorganic Parameters

Inorganic parameters include trace elements (such as metals), major ions, nutrients, and radioactive parameters. Inorganic constituents are typically naturally occurring and can leach from rocks and sediments in contact with groundwater. Anthropogenic sources include industrial and manufacturing facilities.

Water quality in principal aquifers is generally very good; Eighty-two percent of the principal aquifer has low concentrations with respect to health-based Maximum Contaminant Levels (MCLs). Parameters detected in the high range include nitrate, aluminum, and lead. Parameters in the moderate range (above half the MCL) include nitrate + nitrite and chromium. No radioactive parameters were detected above half the MCL.

While health-based drinking water standards have been established for many inorganic parameters, some constituents also have secondary MCLs (SMCL) based on their ability to affect the aesthetic properties of water through taste, color, odor, or by causing staining or scale formation. The SMCL for these parameters may be a single value, or a range, with a lower (recommended) and upper threshold. As shown on the left, inorganic parameters with aesthetic-based standards are found in high concentrations in about 11% of the principal aquifer, and in moderate concentrations in about a third of the aquifer. Iron, manganese, aluminum, TDS, and specific conductance were detected above the SMCL.

Nitrate

Nitrate is naturally occurring in groundwater at low concentrations. However, anthropogenic sources such as fertilizers and septic systems can impact groundwater quality. Nitrate was detected above the MCL in a small portion of the principal aquifer and is likely a legacy issue from agricultural land use, which was widespread historically throughout the Santa Clara Subbasin.

Organic Compounds

Organic compounds include Volatile Organic Compounds (VOCs) and pesticides, and are present in many household, commercial, and industrial products. As shown on the left, groundwater quality in the principal aquifer zone is excellent with respect to organic compounds. While there are localized detections of some VOCs in the Santa Clara Plain, there are minimal impacts to deep drinking water aquifers despite hundreds of sites with known releases in the shallow aquifer zone.

Figure 2-20. Santa Clara Subbasin Principal Aquifer Concentrations Relative to Primary Drinking Water Standards (2010–2019)

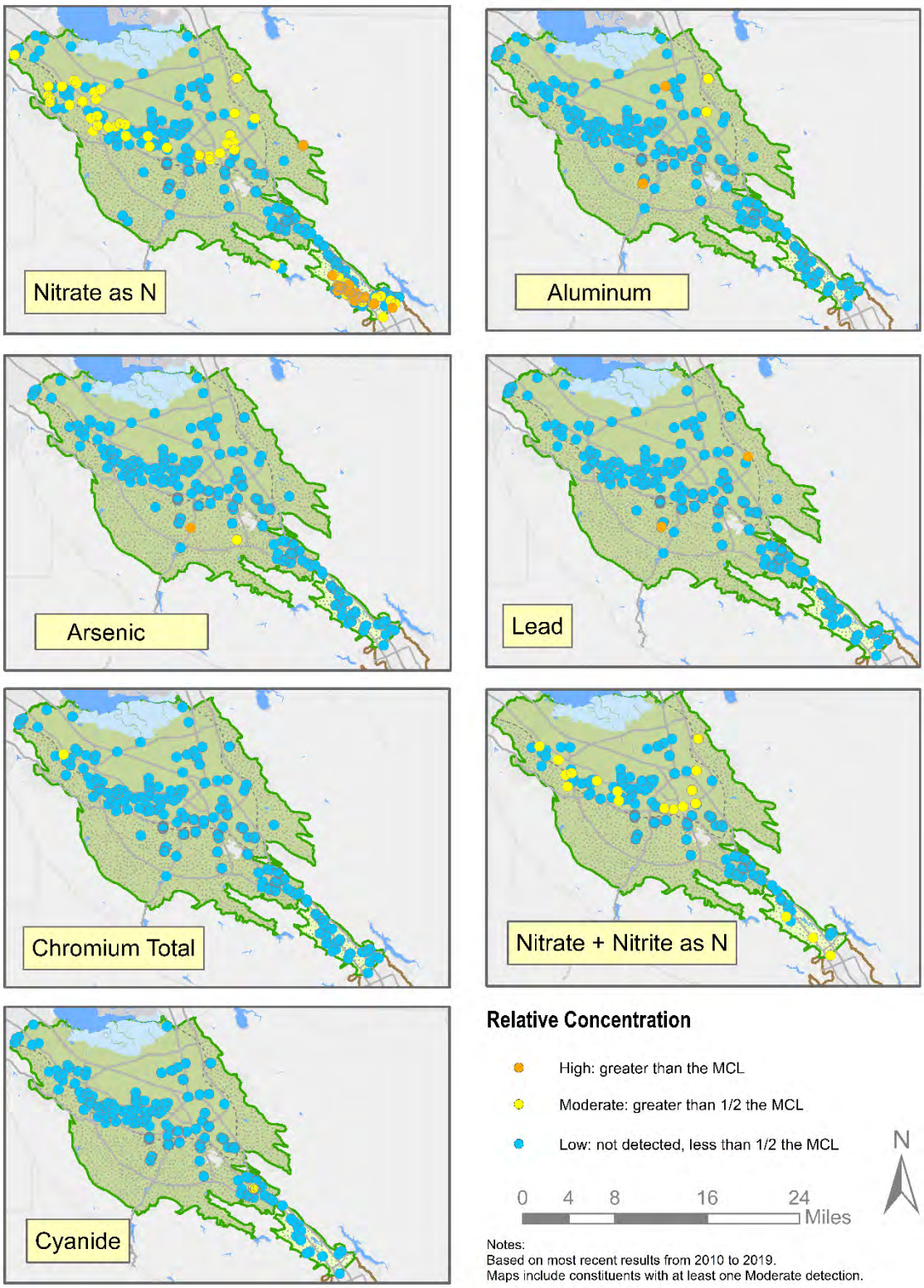
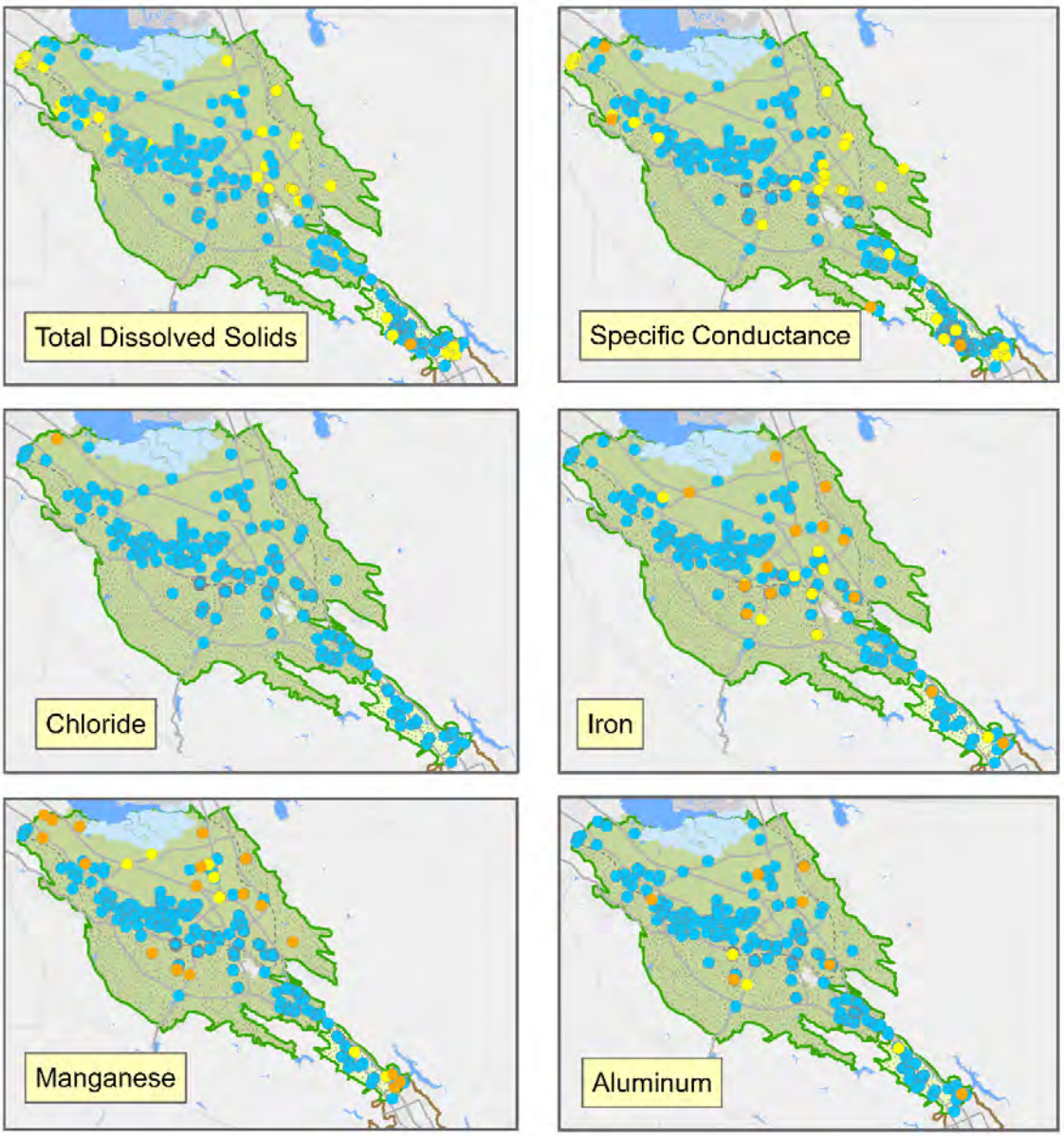


Figure 2-21. Santa Clara Subbasin Principal Aquifer Concentrations Relative to Secondary Drinking Water Standards (2010–2019)



Relative Concentration

- High: greater than the SMCL or upper SMCL threshold
- Moderate: greater than 1/2 the SMCL or above the recommended SMCL threshold
- Low: not detected, less than 1/2 the SMCL, or below the recommended SMCL threshold

0 4 8 16 24 Miles

N

Notes:
Based on most recent results from 2010 to 2019.
Maps include constituents with at least one Moderate detection.

Table 2-2. Santa Clara Plain Shallow Aquifer Zone Water Quality Summary (2010–2019)

Parameter[1]	MCL[2]	SMCL	Number of Wells Tested	Results[4]		
				50th Percentile (median)	95th Percentile	IQR
Aluminum (µg/L)	1,000	200	21	16	99	26
Antimony (µg/L)	6	-	21	<1	<1	-
Arsenic (µg/L)	10	-	21	0.9	7	2
Barium (µg/L)	1,000	-	21	106	314	94
Beryllium (µg/L)	4	-	21	<1	<1	-
Bicarbonate (as HCO3) (mg/L)	-	-	21	353	637	142
Boron (µg/L)	-	-	20	183	827	118
Bromide (mg/L)	-	-	26	0.2	0.4	0.09
Cadmium (µg/L)	5	-	21	<1	<1	-
Calcium (mg/L)	-	-	21	64	146	52
Calcium (as CaCO3) (mg/L)	-	-	20	168	365	135
Chloride (mg/L)	-	250[3]	21	60	91	31
Chromium (µg/L)	50	-	21	0.7	4	1
Chromium 6 (Hexavalent) (µg/L)	-	-	21	<1	3	-
Cobalt (µg/L)	-	-	20	<1	<1	-
Copper (µg/L)	1,300	1,000	20	<0.5	7	-
Fluoride (natural source) (mg/L)	2	-	27	0.08	0.4	0.2
Iron (µg/L)	-	300	21	6	772	44
Lead (µg/L)	15	-	21	<1	<1	-
Lithium (µg/L)	-	-	20	7	18	6
Magnesium (mg/L)	-	-	21	40	70	19
Manganese (µg/L)	-	50	21	15	2,123	110
Mercury (µg/L)	2	-	21	<1	<1	-
Molybdenum (µg/L)	-	-	20	1	18	3
Nickel (µg/L)	100	-	21	0.7	4	1
Nitrate (as N) (mg/L)	10	-	27	1.1	8	2.2
Orthophosphate (as PO4) (mg/L)	-	-	28	0.2	1	0.3
Perchlorate (µg/L)	6	-	21	<4	<4	-
Potassium (mg/L)	-	-	21	1.2	3.7	0.71
Selenium (µg/L)	50	-	21	<5	<5	-
Silica (mg/L)	-	-	20	24	34	4.3
Silver (µg/L)	-	100	21	<1	<1	-
Sodium (mg/L)	-	--	21	40	186	29
Specific Conductance (µS/cm)	-	900[3]	26	809	1,923	649
Sulfate (mg/L)	-	250[3]	27	57	274	54
Thallium (µg/L)	2	-	21	<1	<1	-
Total Dissolved Solids (mg/L)	-	500[3]	23	477	917	359

Turbidity, Field (NTU)	-	5	21	0.4	10	2
Vanadium (µg/L)	-	-	20	0.8	4	1
Zinc (µg/L)	-	5,000	21	<50	<50	-

Notes:

Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Parameters analyzed in fewer than five wells are not included.

1. mg/L = milligrams per liter; µg/L = micrograms per liter; MFL = million fibers per liter; µS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units.
2. Maximum Contaminant Level (MCL), or health-based drinking water standard, specified in Title 22 of the California Code of Regulations.
3. Secondary Maximum Contaminant Level (SMCL), or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed.
4. For results with multiple reporting limits, the median, interquartile range (IQR), and 95th percentile were computed using the Maximum Likelihood Estimate (MLE) method.

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Table 2-3. Santa Clara Plain Principal Aquifer Zone Water Quality Summary (2010–2019)

Parameter[1]	MCL[2]	SMCL	Number of Wells Tested	Results[4]		
				50th Percentile (median)	95th Percentile	IQR
Aluminum (µg/L)	1,000	200	245	8.4	123	22
Antimony (µg/L)	6	-	245	<6	<6	-
Arsenic (µg/L)	10	-	244	<2	<2	-
Asbestos (MFL)	7	-	112	<0.2	<0.2	-
Barium (µg/L)	1,000	-	244	120	254	132
Beryllium (µg/L)	4	-	246	<1	<1	-
Bicarbonate (as HCO3) (mg/L)	-	-	237	270	422	109
Boron (µg/L)	-	-	50	133	2,501	117
Bromide (mg/L)	-	-	59	0.1	2	0.1
Cadmium (µg/L)	5	-	244	<1	<1	-
Calcium (mg/L)	-	-	236	65	99	27
Calcium (as CaCO3) (mg/L)	-	-	43	129	280	95
Carbon Dioxide (µg/L)	-	-	149	10,342	85,500	18,733
Chloride (mg/L)	-	250[3]	236	48	97	17
Chromium (µg/L)	50	-	244	<10	<10	-
Chromium 6 (Hexavalent) (µg/L)	-	-	192	2	5	4
Cobalt (µg/L)	-	-	33	<2	<2	-
Copper (µg/L)	1,300	1,000	242	<50	<50	-
Cyanide (µg/L)	150	-	204	<5	<5	-
Fluoride (natural source) (mg/L)	2	-	258	0.1	0.36	0.11
Iron (µg/L)	-	300	237	19	442	137
Lead (µg/L)	15	-	241	<5	<5	-
Lithium (µg/L)	-	-	46	6	19	6
Magnesium (mg/L)	-	-	236	26	57	18
Manganese (µg/L)	-	50	225	<20	168	-
Mercury (µg/L)	2	-	246	<1	<1	-
Molybdenum (µg/L)	-	-	48	1	17	-
Nickel (µg/L)	-	-	230	<10	<10	-
Nitrate (as N) (mg/L)	10	-	268	2.7	7.1	2.9
Nitrate + Nitrite (as N) (mg/L)	10	-	181	3	6	2
Nitrite (as N) (mg/L)	1	-	202	<0.4	<0.2	-
Orthophosphate (as PO4) (mg/L)	-	-	62	0.1	1	0.2
Perchlorate (µg/L)	6	-	247	<4	<4	-
Potassium (mg/L)	-	-	212	1	2	0.3
Selenium (µg/L)	50	-	244	<5	<5	-
Silica (mg/L)	-	-	47	27	37	3.9
Silver (µg/L)	-	100	236	<10	<10	-

Sodium (mg/L)	-	-	236	32	98	16
Specific Conductance (µS/cm)	-	900[3]	249	670	1,018	222
Sulfate (mg/L)	-	250[3]	247	43	82	20
Thallium (µg/L)	2	-	245	<1	<1	-
Total Dissolved Solids (mg/L)	-	500[3]	242	406	635	141
Turbidity, Field (NTU)	-	5	235	0.4	3	0.5
Vanadium (µg/L)	-	-	48	1	7	6
Zinc (µg/L)	-	5,000	236	<50	<50	-

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Parameters analyzed in fewer than five wells are not included.

1. mg/L = milligrams per liter; µg/L = micrograms per liter; MFL = million fibers per liter; µS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units
2. Maximum Contaminant Level (MCL), or health-based drinking water standard, specified in Title 22 of the California Code of Regulations.
3. Secondary Maximum Contaminant Level (SMCL), or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed.
4. For results with multiple reporting limits, the median, interquartile range (IQR), and 95th percentile were computed using the Maximum Likelihood Estimate (MLE) method.

Table 2-4. Santa Clara Plain Shallow Aquifer Zone Organic Parameter Detections (2010–2019)

Parameter	Units[1]	Primary MCL	Number of Wells Tested	Percent of Wells Tested with Detection (%)	Maximum Concentration
1,1,1-Trichloroethane	µg/L	200	20	10	2.1
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	20	5	4.6
Bromomethane	µg/L	-	20	5	0.6
n-Nitrosodi-n-Butylamine (NDBA)	µg/L	-	13	38	5.7
Tetrachloroethene	µg/L	5	20	5	0.8

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Of the 90 organic parameters tested in the shallow aquifer, 85 were not detected.

1. µg/L = micrograms per liter

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Table 2-5. Santa Clara Plain Principal Aquifer Zone Organic Parameter Detections (2010–2019)

Parameter	Units[1]	Primary MCL	Wells Tested	Percent of Wells Tested with Detection (%)	Maximum Concentration
1,1,1-Trichloroethane	µg/L	200	225	10	4.3
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1200	225	<1	18
1,1-Dichloroethene	µg/L	6	225	4	6.3
1,2,3-Trichloropropane	µg/L	0.005	194	1	0.012
Bromodichloromethane (THM)	µg/L	-	106	8	15
Bromoform (THM)	µg/L	-	106	7	25
Chloroform (THM)	µg/L	-	106	7	35
Di(2-Ethylhexyl) Phthalate	µg/L	4	135	1	3.2
Dibromoacetic Acid (DBAA)	µg/L	-	22	5	3.4
Dibromochloromethane (THM)	µg/L	-	106	6	26
Dichloroacetic Acid (DCAA)	µg/L	-	22	14	13
Dichlorodifluoromethane (Freon 12)	µg/L	-	104	<1	13
Diisopropyl Ether	µg/L	-	99	1	3
m,p-Xylene	µg/L	-	110	<1	0.7
Monobromoacetic acid (MBAA)	µg/L	-	22	5	1.7
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	-	17	24	4.1
Perfluorobutanesulfonic acid (PFBS)	ng/L	-	66	21	3.8
Perfluoroheptanoic acid (PFHPA)	ng/L	-	66	3	2.3
Perfluorohexane Sulfonic acid (PFHxS)	ng/L	-	66	67	8.2
Perfluorohexanoic acid (PFHxA)	ng/L	-	66	3	3.1
Perfluorononanoic acid (PFNA)	ng/L	-	66	9	5.2
Perfluorooctanoic acid (PFOA)	ng/L	-	66	5	3.4
Perfluorooctyl Sulfonate (PFOS)	ng/L	-	66	38	8.2
p-Isopropyltoluene	µg/L	-	76	5	0.5
Styrene	µg/L	100	225	<1	0.7
Tetrachloroethene	µg/L	5	225	<1	0.5
Toluene	µg/L	150	226	1	1.9
Total Trihalomethanes	µg/L	80	59	19	57
Trichloroacetic Acid (TCAA)	µg/L	-	22	9	13
Trichloroethene	µg/L	5	225	<1	1.6
Xylenes (Total)	µg/L	1750	201	<1	0.5

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Of the 147 organic parameters tested in the principal aquifer, 115 were not detected. Parameters analyzed in fewer than five wells are not included.
1. µg/L = micrograms per liter; ng/L = nanograms per liter

2.2.5.2 Coyote Valley

Groundwater in the Coyote Valley is typically of good quality. The primary exception is nitrate, which is detected above the MCL in some wells due to historic and ongoing sources. Unlike the Santa Clara Plain, the Coyote Valley is largely rural and agricultural, with ongoing nitrate sources including synthetic fertilizers and septic systems. The 2010 to 2019 median nitrate concentration was 5.1 mg/L (as N) and concentration trends in Coyote Valley remain relatively stable or decreasing. In a step trend analysis covering the ten-year period between 2010 and 2019, the difference in nitrate median concentrations was not statistically significant using the Mann-Whitney test at the 95% confidence level[56]. These results indicate no significant change in nitrate concentrations in Coyote Valley over the ten-year period.

Figures 2-20 and 2-21 show the relative concentrations of inorganic parameters with health-based MCLs and aesthetic-based SMCLs in Coyote Valley for the period 2010 to 2019. Figure 2-22 provides an overview of water quality in the Coyote Valley. Calcium, magnesium, and bicarbonate are the dominant dissolved water-quality parameters. The 2019 median TDS concentration was 384 mg/L.

Summary statistics for the Coyote Valley are presented in Table 2-6 for all inorganic water quality parameters between 2010 and 2019. Tables 2-7 shows organic chemicals detected between 2010 and 2019. Although some organic chemicals are detected in the Coyote Valley, detections are infrequent and are typically low concentrations.

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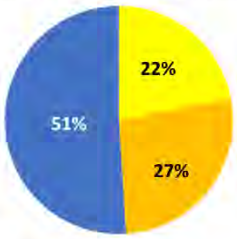
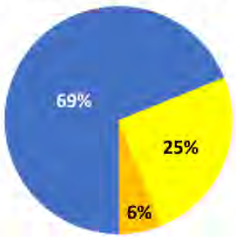
[56] Valley Water, Annual Groundwater Report 2019

Figure 2-22. Coyote Valley Principal Aquifer Water Quality Overview (2010–2019)

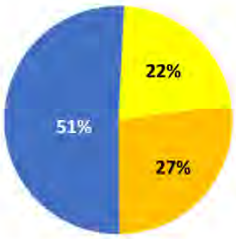
Inorganic Parameters with Health Based Drinking Water Standards



Inorganic Parameters with Secondary Drinking Water Standards



Nitrate



Organic Compounds with Health Based Drinking Water Standards

Low Moderate High

High: greater than the MCL, SMCL, or upper SMCL threshold
Moderate: greater than 1/2 the MCL or SMCL, or above the recommended SMCL threshold
Low: not detected, less than 1/2 the MCL or SMCL, or below the recommended SMCL threshold
Based on the most recent data from 2010-2019.

Inorganic Parameters
Inorganic parameters include trace elements (such as metals), major ions, nutrients, and radioactive parameters. Inorganic constituents are typically naturally occurring and can leach from rocks and sediments in contact with groundwater. Anthropogenic sources include industrial and manufacturing facilities.

Water quality in principal aquifers is generally very good; Fifty-one percent of the principal aquifer has low concentrations with respect to health-based Maximum Contaminant Levels (MCLs). Parameters detected in the high and moderate range include nitrate and nitrate + nitrite. No radioactive parameters were detected above half the MCL.

While health-based drinking water standards have been established for many inorganic parameters, some constituents also have secondary MCLs (SMCL) based on their ability to affect the aesthetic properties of water through taste, color, odor, or by causing staining or scale formation. The SMCL for these parameters may be a single value, or a range, with a lower (recommended) and upper threshold. As shown on the left, inorganic parameters with aesthetic-based standards are found in high concentrations in about 6% of the principal aquifer, and in moderate concentrations in about a quarter of the aquifer. Iron, manganese, aluminum, TDS, and specific conductance were detected above the SMCL.

Nitrate
Nitrate is naturally occurring in groundwater at low concentrations. However, anthropogenic sources such as fertilizers and septic systems can impact groundwater quality. Nitrate was detected above the MCL in 27% of the Coyote Valley. The source of nitrate is historical and ongoing agricultural practices and use of septic system.

Organic Compounds
Organic compounds include Volatile Organic Compounds (VOCs) and pesticides, and are present in many household, commercial, and industrial products. As shown on the left, groundwater quality in the principal aquifer zone is excellent with respect to organic compounds. There were localized detections of some VOCs in the Coyote Valley, but none exceeding half the MCL.

Table 2-6. Coyote Valley Groundwater Quality Summary (2010–2019)

Parameter[1]	MCL[2]	SMCL	Number of Wells Tested	Results[4]		
				50th Percentile (median)	95th Percentile	IQR
Aluminum (µg/L)	1,000	200	32	18	144	35
Antimony (µg/L)	6	-	31	<6	<6	-
Arsenic (µg/L)	10	-	32	<2	<2	-
Asbestos (MFL)	7	-	7	<0.2	<0.2	-
Barium (µg/L)	1,000	-	32	104	220	65
Beryllium (µg/L)	4	-	31	<1	<1	-
Bicarbonate (as HCO3) (mg/L)	-	-	27	232	383	95
Boron (µg/L)	-	-	13	117	140	58
Bromide (mg/L)	-	-	85	0.1	0.3	0.1
Cadmium (µg/L)	5	-	32	<1	<1	-
Calcium (mg/L)	-	-	27	47	84	16
Calcium (as CaCO3) (mg/L)	-	-	13	122	192	32
Carbon Dioxide (µg/L)	-	-	6	1,650	5,050	-
Chloride (mg/L)	-	250[3]	27	43	119	17
Chromium (µg/L)	50	-	32	1	5	2
Chromium 6 (Hexavalent) (µg/L)	-	-	26	2	8	3
Cobalt (µg/L)	-	-	13	<1	<1	-
Copper (µg/L)	1,300	1,000	27	0.5	3	-
Cyanide (µg/L)	150	-	18	<100	<100	-
Fluoride (natural source) (mg/L)	2	-	101	0.1	0.2	0.06
Iron (µg/L)	-	300	27	12	506	54
Lead (µg/L)	15	-	29	<5	<5	-
Lithium (µg/L)	-	-	13	11	27	3
Magnesium (mg/L)	-	-	27	33	65	12
Manganese (µg/L)	-	50	27	2	152	13
Mercury (µg/L)	2	-	31	<1	<1	-
Molybdenum (µg/L)	-	-	13	<1	10	-
Nickel (µg/L)	100	-	32	<1	2	-
Nitrate (as N) (mg/L)	10	-	107	5.1	17	8.2
Nitrate + Nitrite (as N) (mg/L)	10	-	15	2	7	4
Nitrite (as N) (mg/L)	1	-	19	<0.4	<0.4	-
Orthophosphate (as PO4) (mg/L)	-	-	94	0.05	0.3	0.07
Perchlorate (µg/L)	6	-	30	<4	<4	-
Potassium (mg/L)	-	-	24	1	2	0.4
Selenium (µg/L)	50	-	32	<5	<5	-
Silica (mg/L)	-	-	13	23	34	6.5
Silver (µg/L)	-	100	27	<10	<10	-
Sodium (mg/L)	-	-	27	27	110	5.5
Specific Conductance (µS/cm)	-	900[3]	89	646	991	155
Sulfate (mg/L)	-	250[3]	96	41	62	19

Thallium (µg/L)	2	-	31	<1	<1	-
Total Dissolved Solids (mg/L)	-	500[3]	54	388	641	94
Turbidity, Field (NTU)	-	5	25	0.3	12	2
Vanadium (µg/L)	-	-	13	<3	5	-
Zinc (µg/L)	-	5,000	27	<50	260	-

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used.
1. mg/L = milligrams per liter; µg/L = micrograms per liter; MFL = million fibers per liter; µS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units.
2. Maximum Contaminant Level (MCL), or health-based drinking water standard, specified in Title 22 of the California Code of Regulations.
3. Secondary Maximum Contaminant Level (SMCL), or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed.
4. For results with multiple reporting limits, the median, interquartile range (IQR), and 95th percentile were computed using the Maximum Likelihood Estimate (MLE) method.

Table 2-7. Summary of Organic Parameters Detected in the Coyote Valley (2010–2019)

Parameter	Units[1]	Primary MCL	Wells Tested	Percent of Wells Tested with Detection (%)	Maximum Concentration
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	26	4	0.9
Ethylbenzene	µg/L	300	26	4	0.7
m,p-Xylene	µg/L	-	21	5	4
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	-	7	14	2.3
o-Xylene	µg/L	-	21	5	1.2
Tert-Butyl Alcohol (TBA)	µg/L	-	15	13	4.1
Toluene	µg/L	150	26	4	9.6
Xylenes (Total)	µg/L	1,750	23	4	5.2

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Of the 90 organic parameters tested in the Coyote Valley, 8 were not detected.
1. µg/L = micrograms per liter; ng/L = nanograms per liter

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2.2.6 Seawater Intrusion

Due to historic high groundwater pumping and land subsidence, particularly in the years following World War II, seawater intrusion has been observed in the shallow aquifer of the Santa Clara Plain. The 2021 GWMP includes a new seawater intrusion outcome measure that will be further explained in Chapter 5. The development of a seawater intrusion outcome measure is one of five recommended actions by DWR in their review and approval of the 2016 GWMP as an Alternative Plan (Appendix C). A detailed technical memorandum that documents the current understanding, approach, and methods used to develop the seawater intrusion outcome measure is included in Appendix H. The following summarizes the current extent and processes that influence seawater intrusion in the Santa Clara Plain. There is no seawater intrusion in the Coyote Valley.

Seawater intrusion (SWI) (also called saltwater intrusion) refers to the temporary or permanent flux of seawater into coastal freshwater aquifers. Seawater intrusion is a groundwater management concern because it can degrade groundwater quality and, if severe enough, result in undesirable conditions that may include limiting groundwater as a water supply for municipal and industrial uses, agriculture, and domestic uses, or degrading GDEs or infrastructure. Reclaiming freshwater aquifers after SWI is very costly and time-consuming, if not practically infeasible in many cases. Therefore, sustainable groundwater management programs and actions that prevent or mitigate SWI are preferred to costly remediation.

Saltwater intrusion in the shallow aquifer zone of the Santa Clara Plain is largely attributed to incursion of water from San Francisco Bay into the tidal reaches of creeks and subsequent transport to shallow groundwater through streambed percolation Figure 2-23. This seawater incursion was exacerbated by land subsidence, which decreased the elevation of the land surface adjacent to San Francisco Bay, causing further inland movement along tidal creeks. The degree of SWI in the shallow aquifer zone is assessed by the chloride content in monitoring wells located in the baylands area adjacent to southern San Francisco Bay. Valley Water uses a chloride concentration of 100 mg/L to indicate the first sign of influence from seawater (Figure 2-24). This is a conservative threshold, since the aesthetic based MCL for chloride is 250 mg/L.

Wells with chloride over 100 mg/L are located in a narrow band adjacent to the former salt evaporation ponds, except in the areas adjacent to Guadalupe River and Coyote Creek affected due to tidal incursion in these channels (Figure 2-23). High chloride concentrations up to several thousand parts per million are observed near the levee system that defines the former salt evaporation ponds and are indicative of the classic case of SWI (Figure 2-24) (Appendix H). However, the leakance of saltwater beneath tidal stream flow has a larger influence on the spatial extent of the 100 mg/L chloride isocontour (Figure 2-24) (Appendix H).

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Figure 2-23. Conceptual Diagram of Seawater Intrusion (SWI) in the Santa Clara Subbasin by the Mechanism of Leakance of Saltwater Beneath Tidal Streamflow

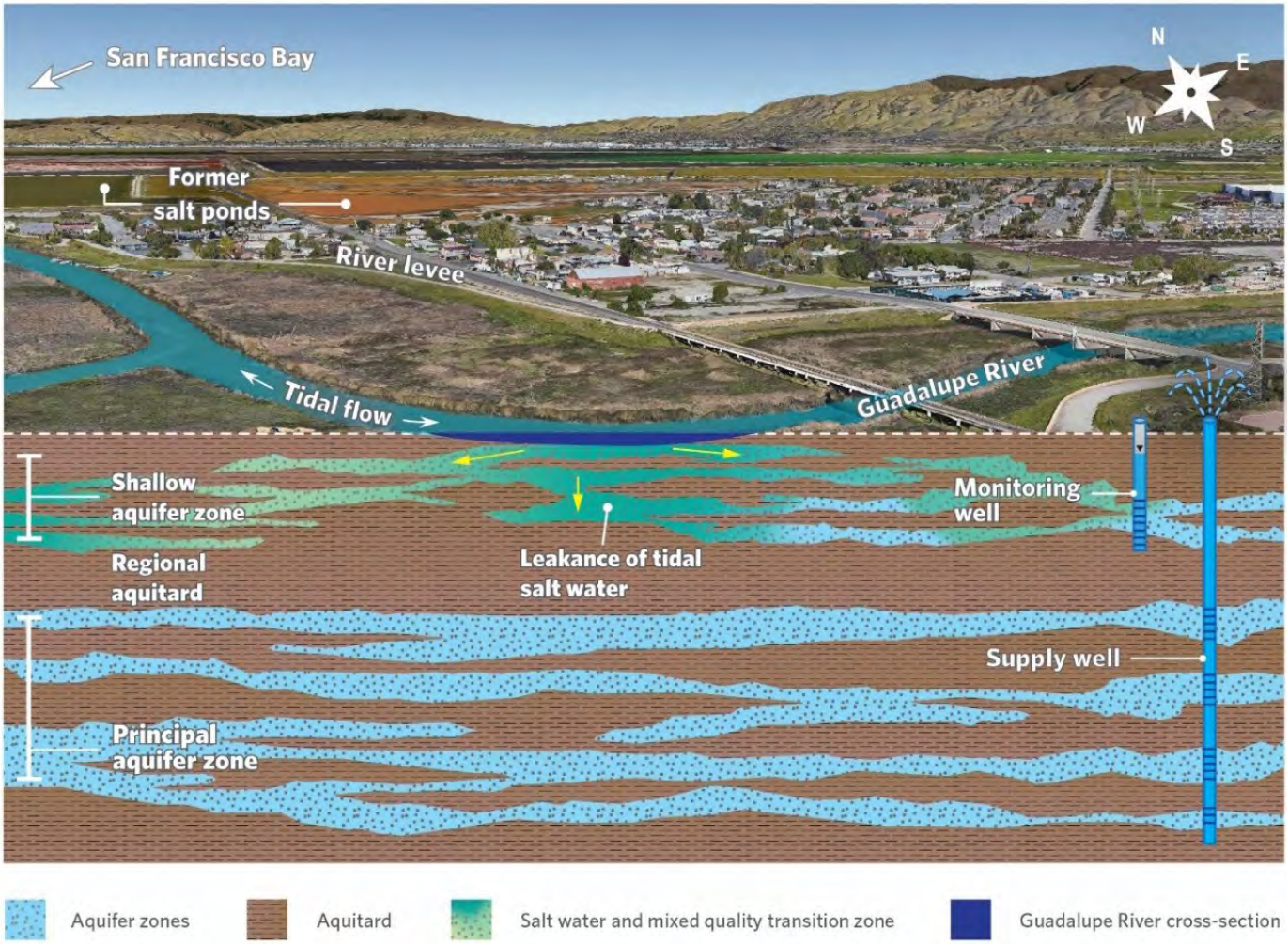

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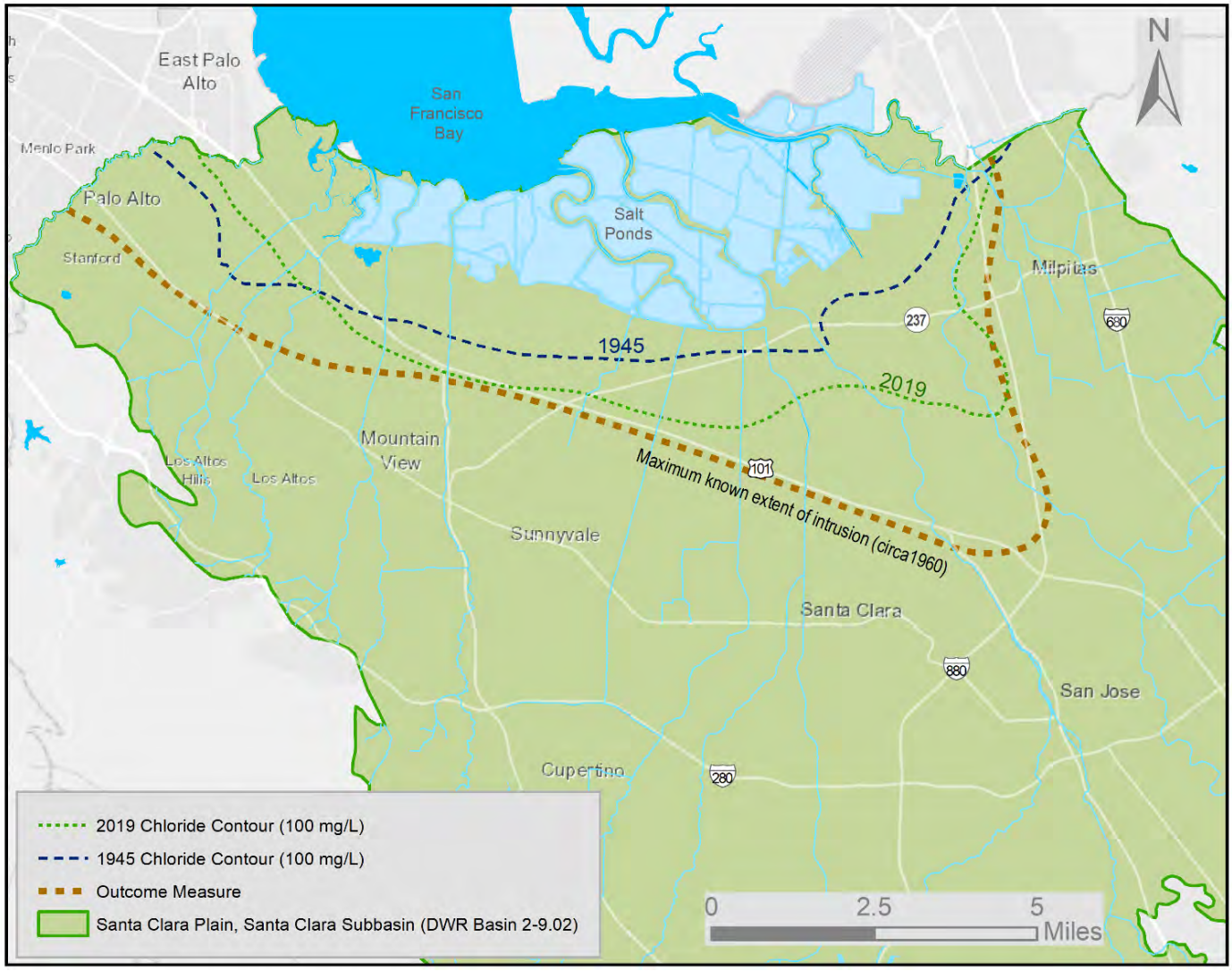
Figure 2-24. Extent of Seawater Intrusion in the Santa Clara Plain Shallow Aquifer Zone



Historically, the classic case of seawater intrusion (via direct, subsurface flow) has affected only a small portion of the shallow aquifer zone beneath and immediately adjacent to the Bay and salt ponds (Figure 2-25), and thus is a minimal threat to groundwater supply because the principal aquifer zone is protected by the regional aquitard and chloride concentrations in the principal aquifer are relatively low beneath much of the 100 mg/L chloride isocontour in the shallow aquifer zone. The relatively minor intrusion into the deeper, principal aquifer zone is believed to be due to some classic SWI and inter-aquifer transfer through improperly destroyed wells (Appendix H). Presently, the monitoring network in the Baylands area has limited coverage of the principal aquifer zone. Recommendations for additional monitoring for SWI are outlined in Appendix H.

The following section summarizes the relative role of each of the four SWI mechanisms in terms of affecting the 100 mg/L chloride isocontour across the Santa Clara Subbasin (Appendix H). The parts of the groundwater system(s) most at risk from each of the four SWI mechanisms is also summarized here.

"Classic" SWI: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism is largely constrained by the hydrogeologic setting of the

subbasin, which include thick deposits of Bay mud that have very low hydraulic conductivity and create confined, semi-confined, and perched groundwater conditions. The shallow aquifer zone is the part of the system most at risk from this SWI mechanism.

Leakance of saltwater beneath tidal stream flow: this mechanism likely has a relatively major role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism is largely constrained to areas near tidal rivers and creeks but can migrate laterally in the shallow aquifer system. The shallow aquifer zone, especially near the Guadalupe River and Coyote Creek, is the part of the system that is most at risk from this SWI mechanism.

By-pass flow down improperly constructed or destroyed wells: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. However, if this mechanism occurs, it presents the greatest risk to groundwater quality in the principal aquifer zone.

Entrapped connate water: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism has a localized influence on groundwater quality in the shallow and principal aquifer zone near the bayfront in Palo Alto.

Climate change and associated sea-level rise may exacerbate some of the mechanisms that affect SWI and the spatial extent of the 100 mg/L isocontour line (Figure 2-26) (Appendix H). Sea-level rise is expected to have a relatively larger influence on the leakance of saltwater beneath the tidal stream flow as compared to classic case of SWI because of the thick deposits of Bay mud that have very low hydraulic conductivity and create confined, semi-confined, and perched groundwater conditions (Appendix H).

Figure 2-25. Classic Seawater Intrusion Beneath the South San Francisco Bay and Former Salt Ponds

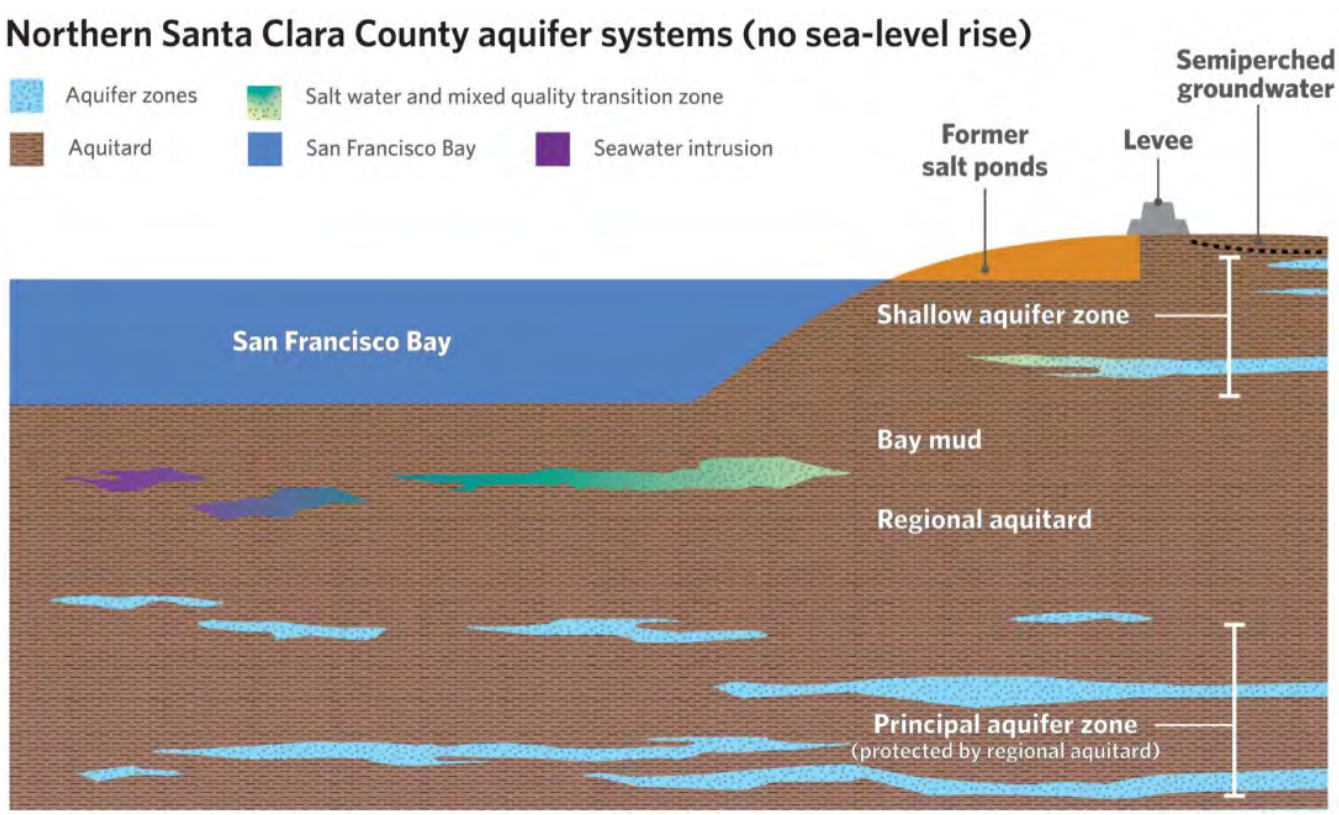
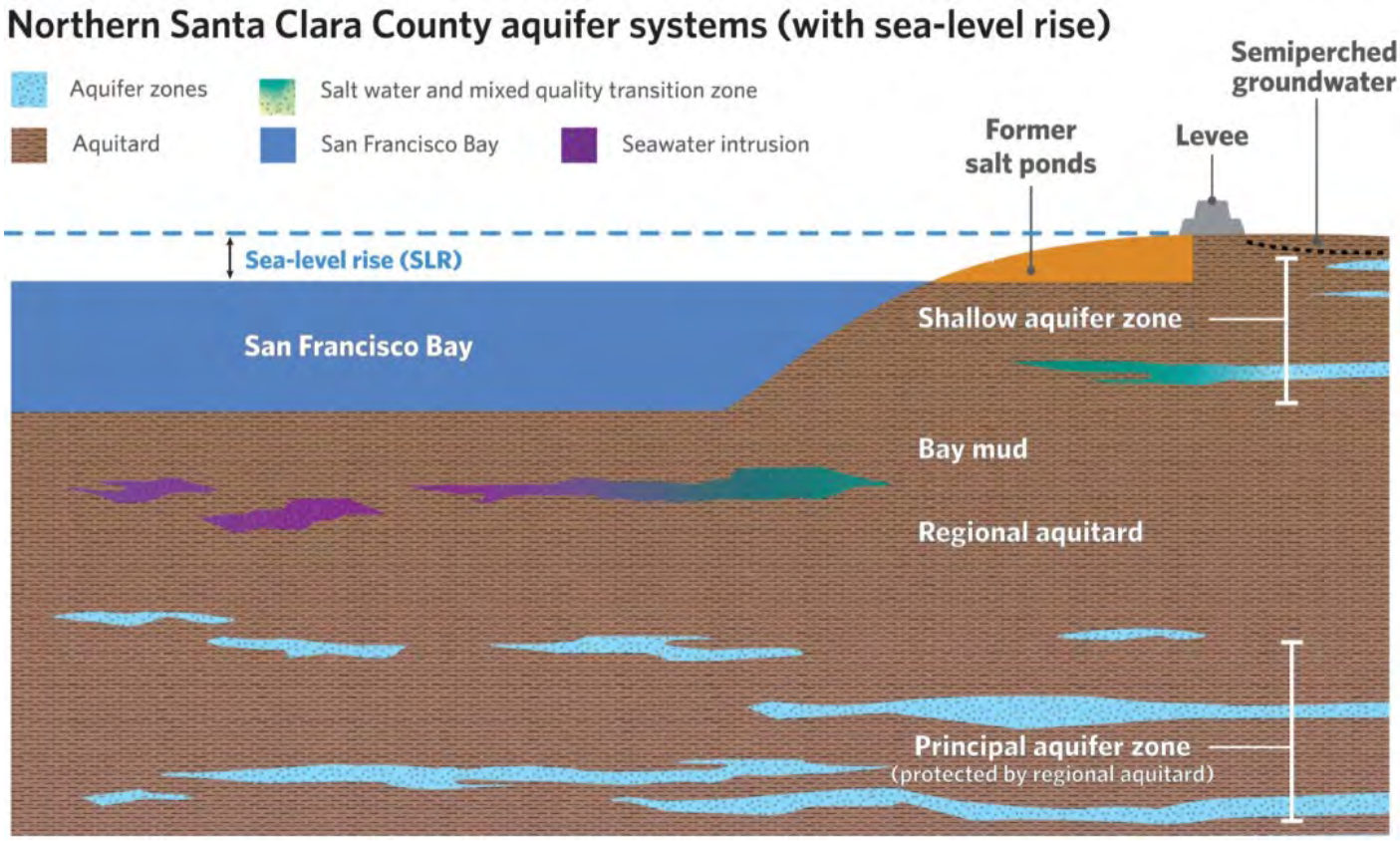


Figure 2-26. Sea-Level Rise Effects on Seawater Intrusion Beneath the South San Francisco Bay and Former Salt Ponds



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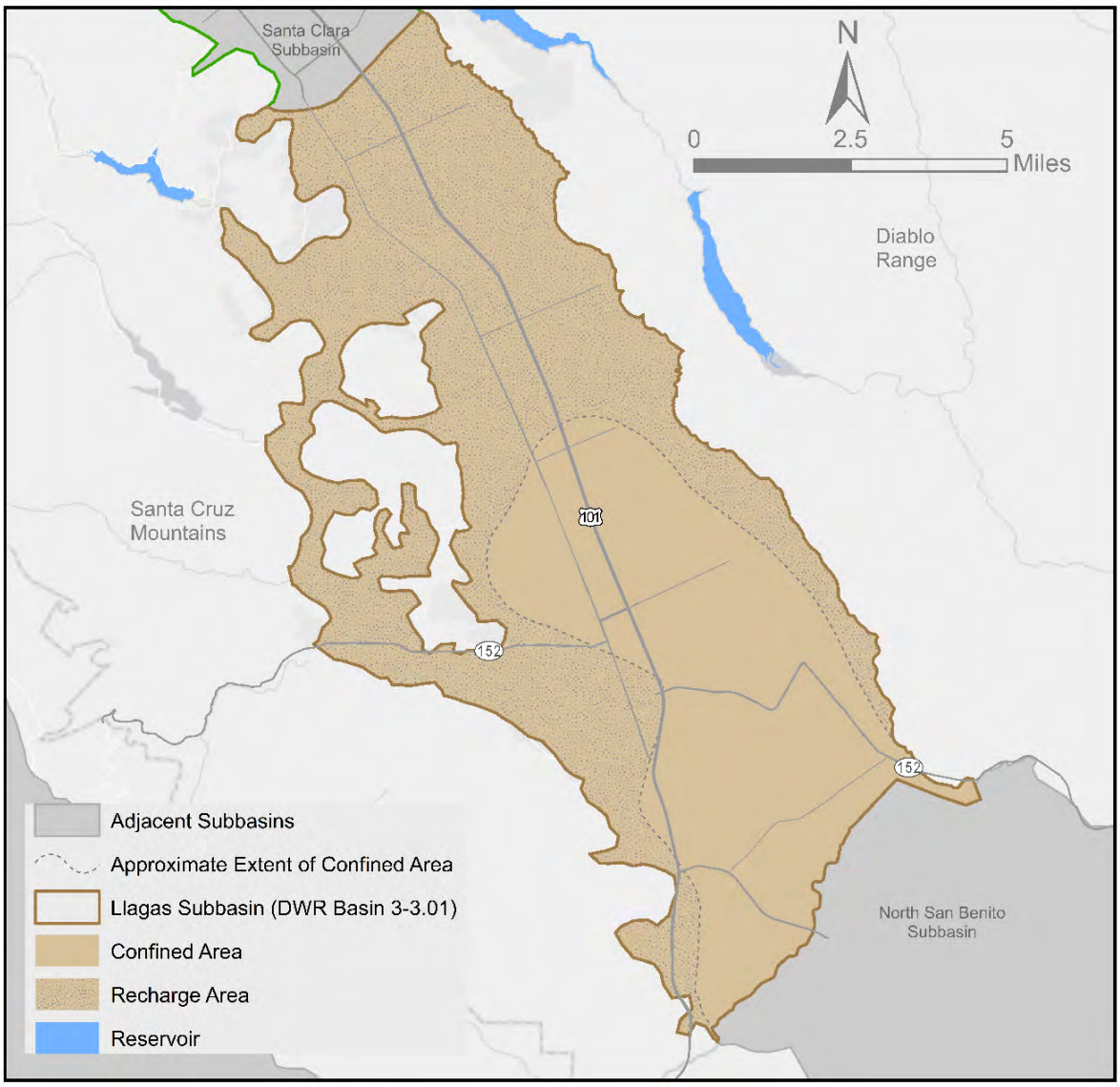
CHAPTER 3 – LLAGAS SUBBASIN DESCRIPTION

This chapter describes the Llagas Subbasin, including the physical setting and characteristics, and conditions related to groundwater elevation, water quality, land subsidence, groundwater/surface water interaction, GDEs, and seawater intrusion.

3.1 BASIN SETTING

The Llagas Subbasin (DWR Basin Number 3-3.01) is located within the California Coast Ranges physiographic province between the San Andreas and Calaveras Fault zones. The subbasin is part of the larger Gilroy-Hollister Valley Groundwater Basin (Basin 3-3), which extends into San Benito County to the south. Similar to the Santa Clara Subbasin, the Llagas Subbasin underlies a relatively flat valley and consists of unconsolidated alluvial sediments.

Figure 3-1. Llagas Subbasin



3.1.1 Lateral Subbasin Boundaries

The Llagas Subbasin covers a surface area of about 88 square miles and forms a northwest-trending, elongated valley bounded by the Santa Cruz Mountains to the west and the Diablo Range to the east. The Llagas Subbasin is about 15 miles long in the northwest/southeast direction and 3 to 6 miles wide. The basis for the lateral boundary delineation is the geologic, hydrologic and topographic features in the subbasin.

The Llagas Subbasin is the northern extension of the Gilroy-Hollister Valley Groundwater Basin, which was created by offset along the major faults. The western and eastern subbasin boundaries are the geologic contact between permeable to semi-permeable alluvial sediments within the valley and the impermeable bedrock of the adjacent mountain ranges. The Santa Cruz Mountains and Diablo Range on either side of the subbasin are primarily composed of sedimentary, metamorphic, and volcanic rocks of Jurassic, Cretaceous and Tertiary age.[57] The northern boundary with the Santa Clara Subbasin is the Coyote Creek alluvial fan in the Morgan Hill area, which forms a topographic and hydrologic divide between the groundwater and surface water flowing to the San Francisco Bay and water flowing to the Monterey Bay. The groundwater divide is approximately located at the Cochrane Road area in Morgan Hill. Based on observed water level data, the boundary moves as much as a mile to the north or south depending on local groundwater conditions. The subbasin's southern boundary is institutional, coincident with the boundary between Santa Clara and San Benito counties and adjacent to the North San Benito Subbasin.

3.1.2 Recharge Areas

Like the Santa Clara Subbasin, the Llagas Subbasin has two hydrogeologic areas, the recharge area where groundwater is generally unconfined, and the confined area (Figure 3-1). The recharge area is located at the north, western, and eastern edges of the subbasin and is the area where active groundwater recharge takes place due to high lateral and vertical permeability. Fine-grained materials are not laterally continuous in the recharge area, though localized confined conditions can occur.

In the southern and central portion of the subbasin, clays and silts become more vertically and laterally extensive creating confined artesian conditions, especially in the southern portion near the Pajaro River. Within the confined area, low permeability units restrict the vertical flow of groundwater and divide the subbasin into shallow and principal aquifer zones. The boundary between the recharge and confined areas was originally defined based on flowing artesian wells.[58] The boundary is gradual and broad, and not as precise as its depiction on Figure 3-1.

3.1.3 Principal Aquifers and Aquitards

The Llagas Subbasin is a structural depression filled with Quaternary alluvium deposits of unconsolidated gravel, sand, silt and clay that eroded from adjacent mountain ranges by flowing water and were deposited into the valley (Figure 3-2). As in the Santa Clara Subbasin, the alluvium comprises interfingering alluvial fans, stream deposits and terrace deposits.

The Llagas Subbasin is comprised of unconsolidated alluvial sediments, with intercalated and discontinuous layers of gravel and sand (aquifer materials) and clay and silt (confining units) at various depths beneath the ground surface. The subbasin ranges in thickness from about 500 feet at the northern boundary to over 1,000 feet thick beneath the Pajaro River. The major aquitard forming the regional confining layer is commonly encountered between 20 and 100 feet below ground surface, and ranges in thickness from 40 to 100 feet.[59] Shallow aquifer zones generally refer

57 Graymer, et al., Geologic Map of the San Francisco Bay Region, 2006.
58 Clark, Ground Water in Santa Clara Valley, California, 1924.
59 Santa Clara Valley Water District, Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County, 1989.

to aquifers that occur within 150 feet of ground surface, while principal aquifer zones generally occur at depths below 150 feet. Cross-sections of the Llagas Subbasin are presented in Figures 3-3 through 3-6.

Figure 3-2. Quaternary Alluvium Geologic Map of the Llagas Subbasin

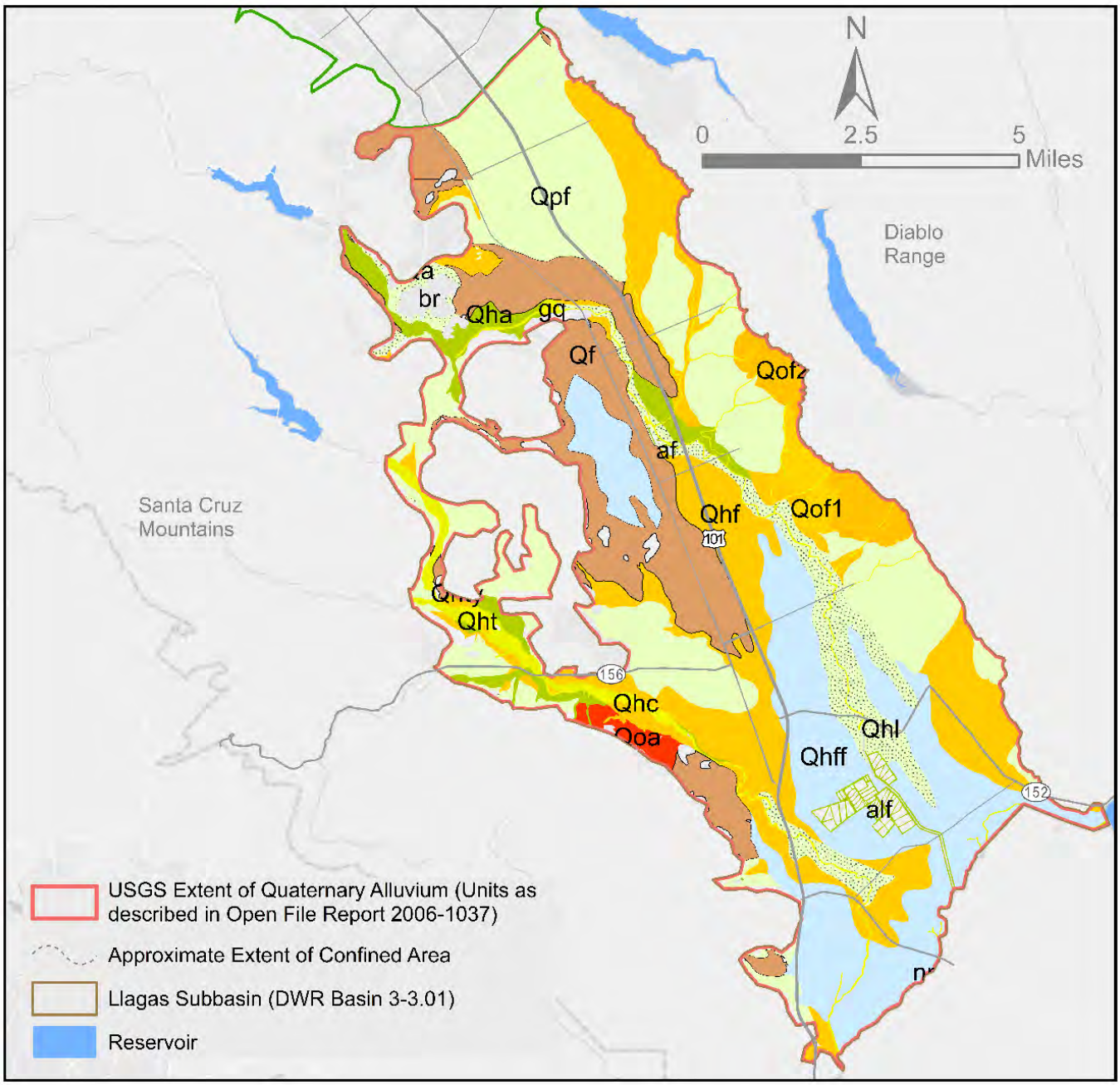


Figure 3-3. Llagas Subbasin Cross-Section Locations

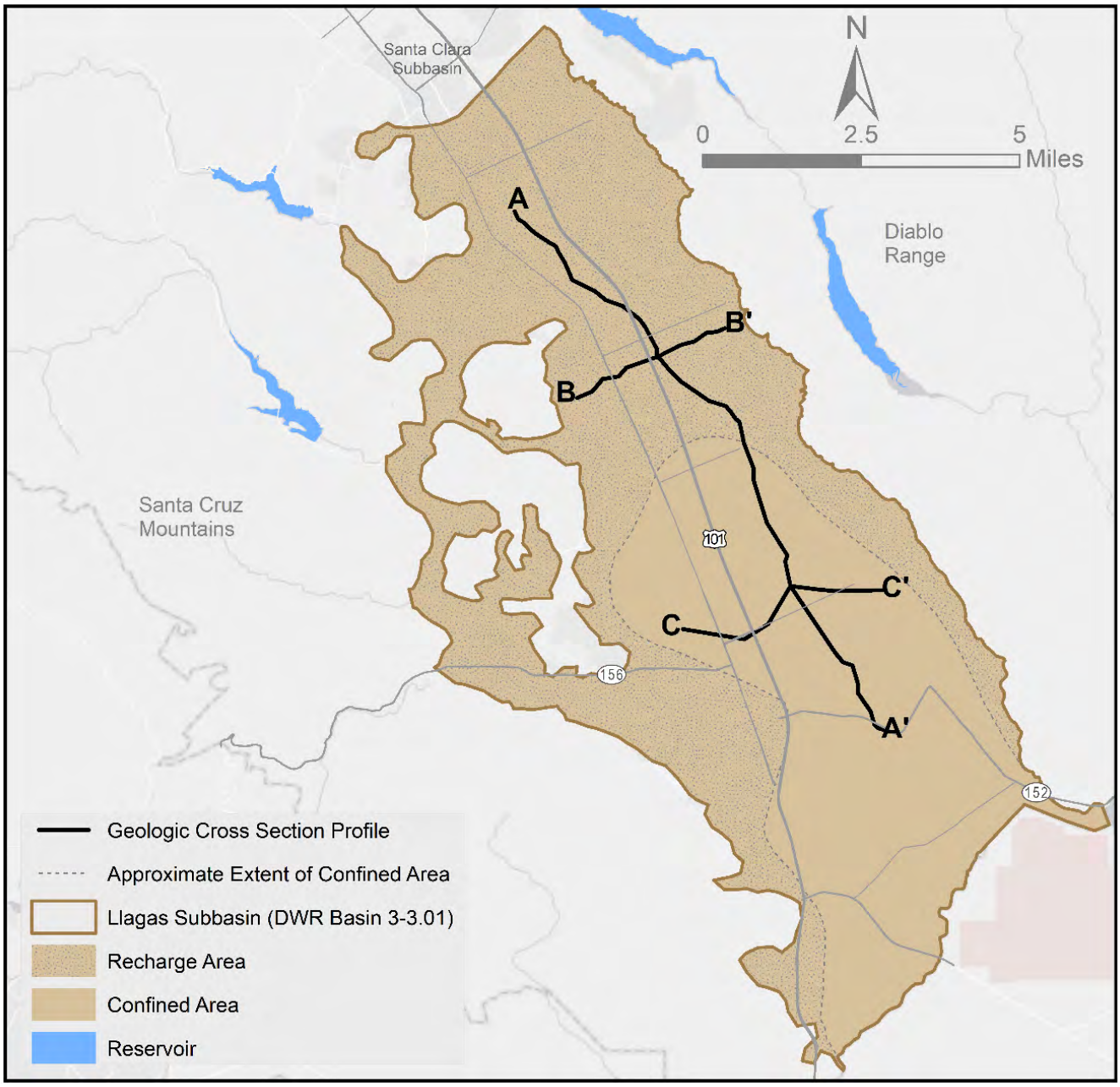


Figure 3-4. Llagas Subbasin Longitudinal Cross-Section

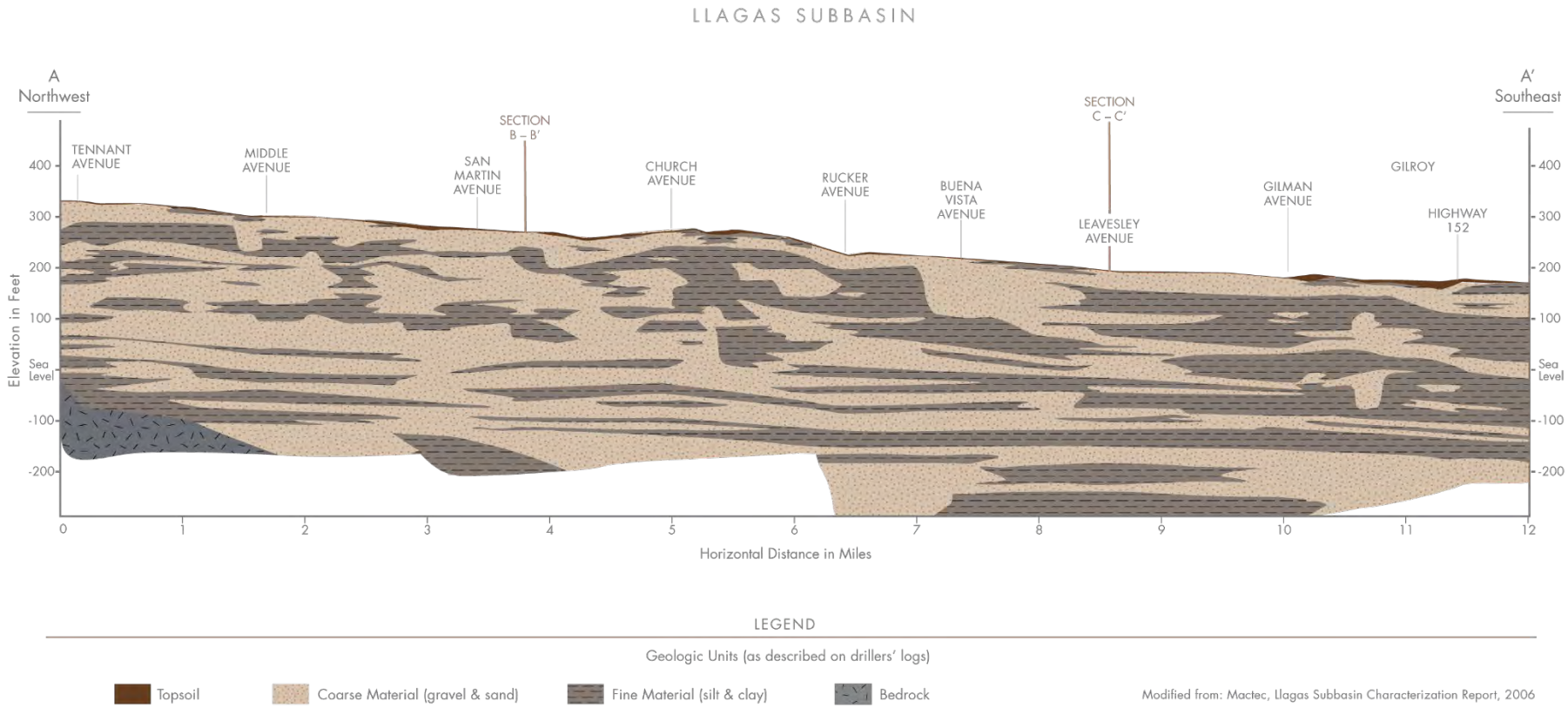


Figure 3-5. Llagas Subbasin Northern Transverse Cross-Section

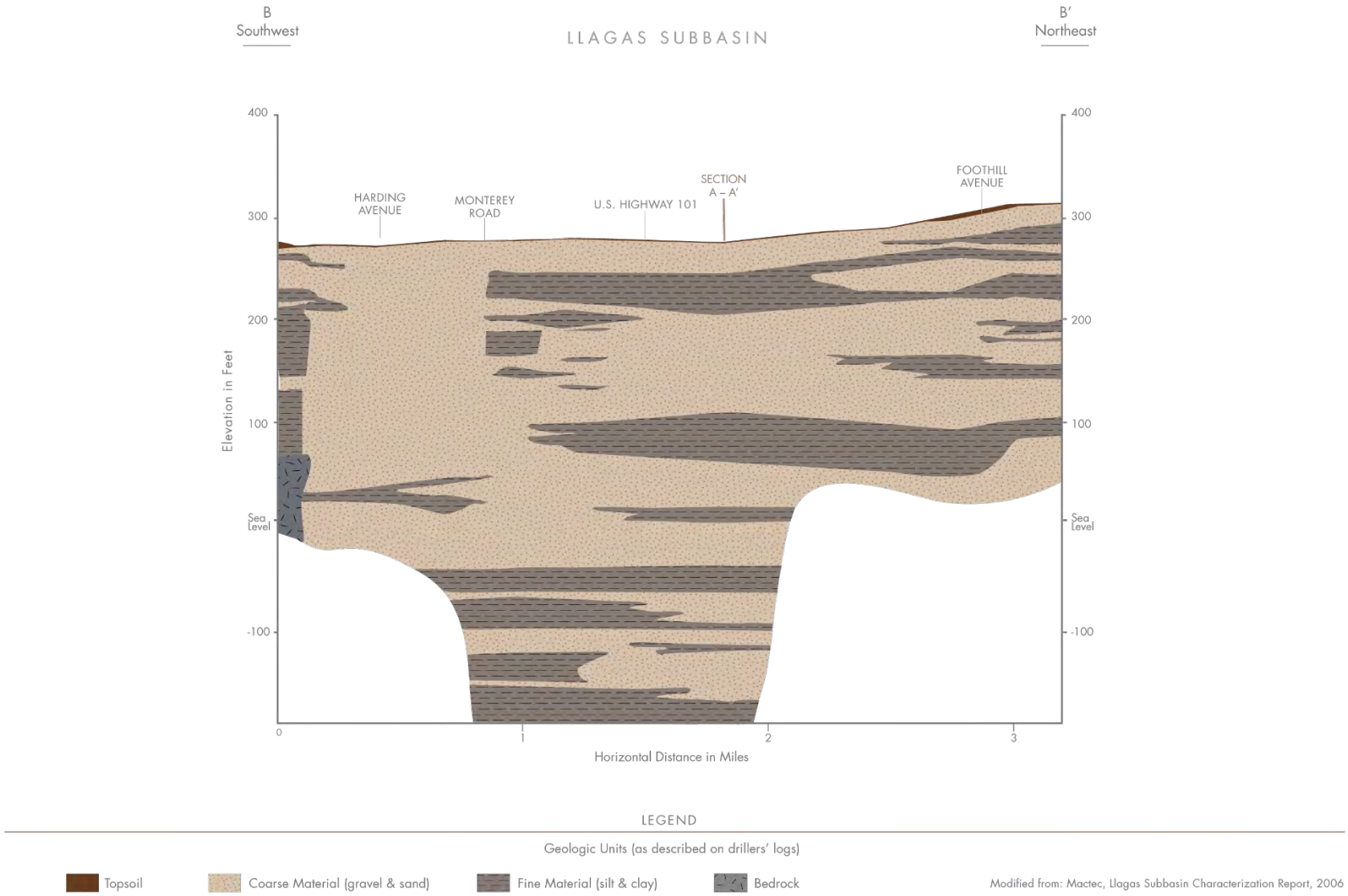
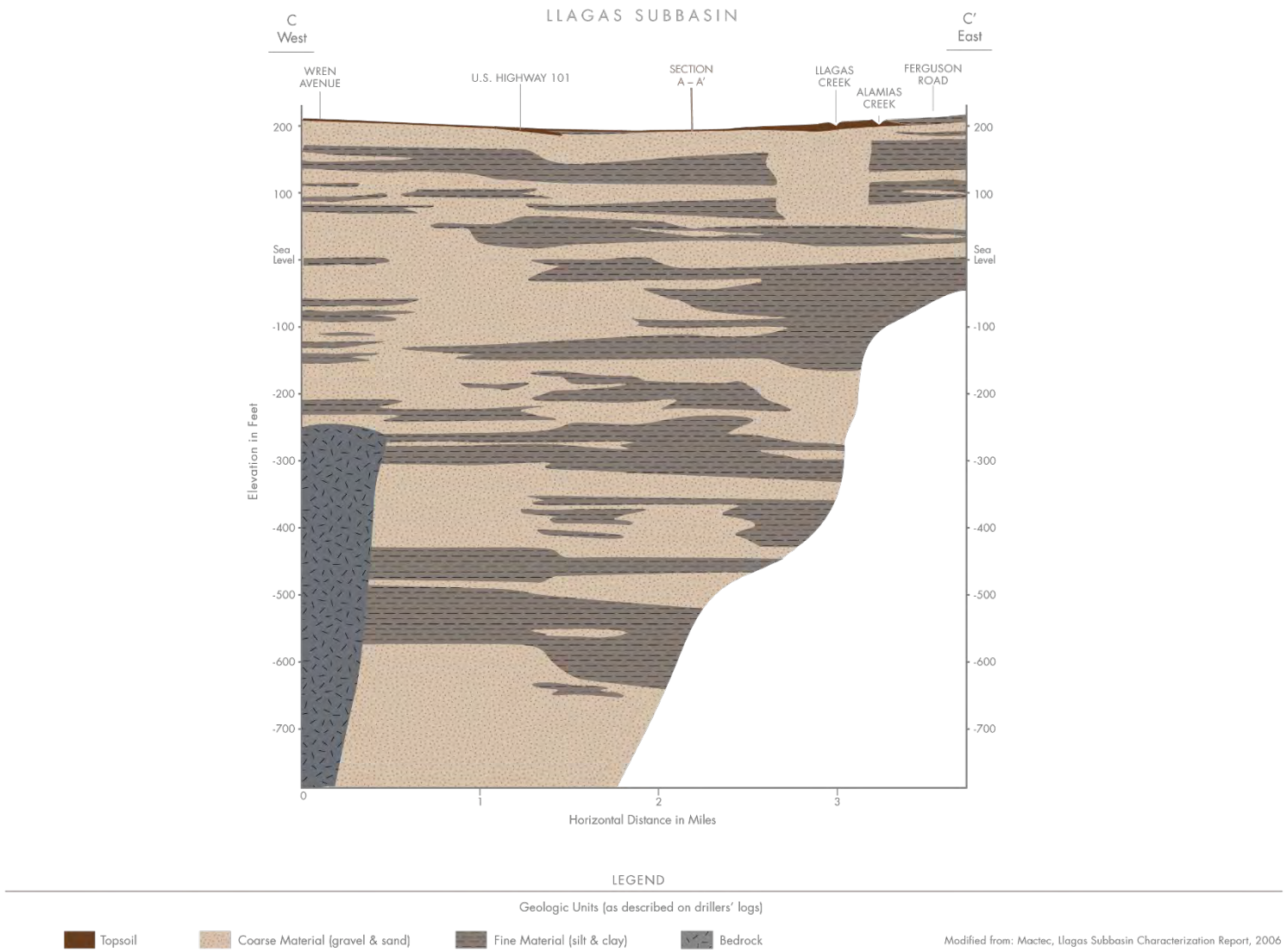


Figure 3-6. Llagas Subbasin Southern Transverse Cross-Section



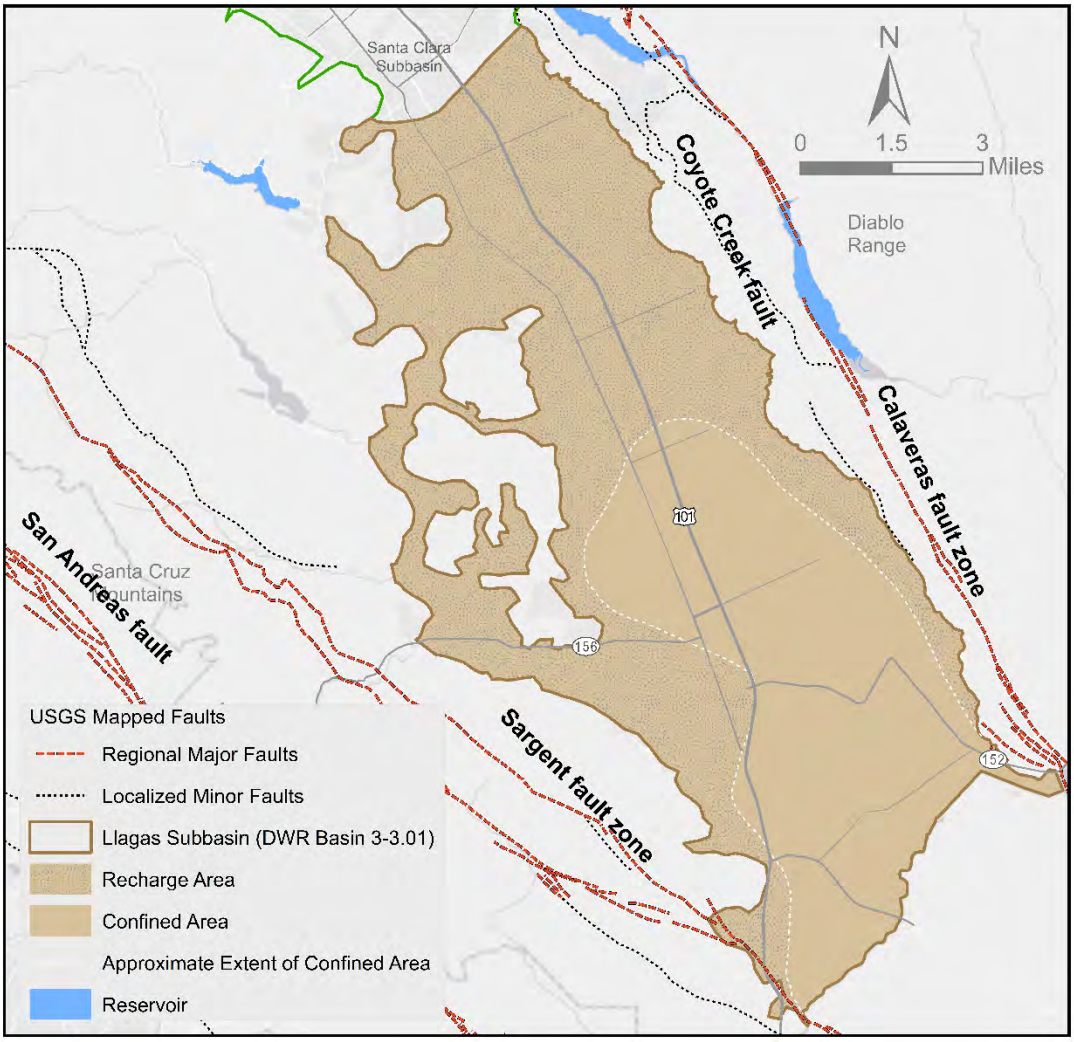
3.1.4 Subbasin Bottom

The bottom of the Llagas Subbasin is the geologic contact between unconsolidated alluvium and bedrock, an irregular surface occurring at varying depths. The alluvium thickness ranges from a few feet at the western and eastern edges of the subbasin to about 500 feet at the apex of the Coyote Creek alluvial fan in Morgan Hill and deepens to over 1,000 feet beneath the Pajaro River. Based on available drillers logs, most water supply and groundwater monitoring wells do not encounter bedrock, including a well recently drilled to a depth of 1,015 feet in the south central area of the subbasin. Borehole data suggest that the depth to bedrock is highly variable throughout the subbasin.

3.1.5 Major Faults

Major northwest trending faults flank the structural trough that is the Llagas Subbasin, including the San Andreas Fault system in the Santa Cruz Mountains and the Calaveras and Coyote Creek Faults east of the subbasin in the Diablo Range (Figure 3-7).

Figure 3-7. Major Faults



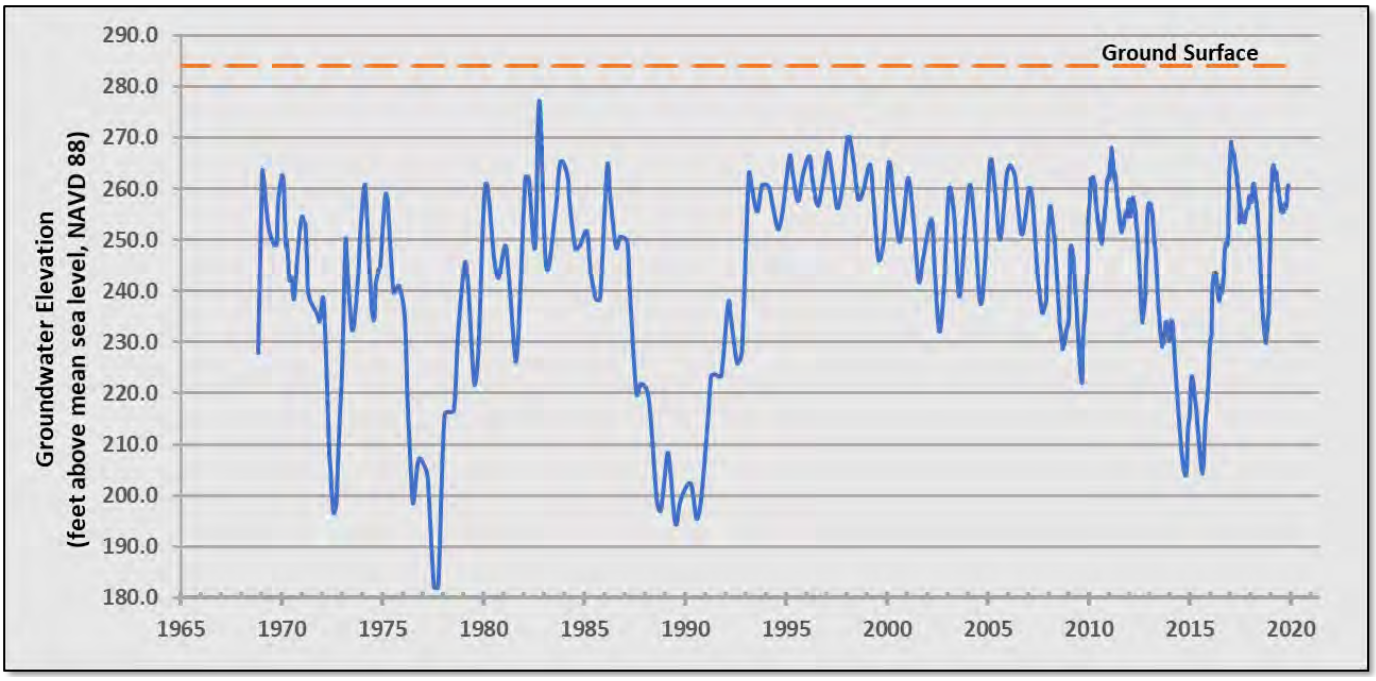
3.2 SUBBASIN CONDITIONS

This section describes Llagas Subbasin conditions with regard to groundwater elevation, flow, quality, land subsidence, surface water/groundwater interaction, GDEs, and seawater intrusion.

3.2.1 Groundwater Elevation and Flow

Groundwater movement in the Llagas Subbasin generally follows surface water patterns, draining south toward the Pajaro River at the boundary with San Benito County. Locally, groundwater also moves toward areas of intense pumping. Vertical gradients in the subbasin are predominately downward, although several monitoring wells at the southern end of the subbasin would flow artesian if not capped. Historic marshes located east of Gilroy and south of Pacheco Highway indicate an area of upward flow and groundwater discharge. Figure 3-8 is a long-term hydrograph for the regional index well in the Llagas Subbasin.

Figure 3-8. Groundwater Elevation in the Llagas Subbasin Regional Index Well (10S03E01N005)



Note: The original regional index well (10S03E13D003) was destroyed by the owner in April 2019 and was replaced in November 2019 by Valley Water with well 10S03E13E007. Due to an apparent obstruction, well 10S03E13E007 was replaced in December 2020 with 10S03E01N005, based on proximity to and similarities in the well construction and water level hydrographs as the original well 10S03E13D003.

Groundwater elevation contour maps depict the groundwater table or potentiometric surface associated with spring 2019 (Figure 3-9) and fall 2019 (Figure 3-10) for the Llagas Subbasin. Groundwater flows from north to south or slightly southeast, generally following the topography. The groundwater elevation is highest near Cochrane Road in Morgan Hill in the north, while the lowest elevation is typically found in the southernmost part of the subbasin near the Pajaro River. In the upper part of the subbasin, there are some flows from mountain or hill areas.

As indicated by the contour maps (Figures 3-9 and 3-10), typical seasonal patterns result in higher groundwater elevations in the spring and lower elevations in the fall. Contour maps for 2019 are included since that represents the most recent year where water levels were not significantly affected by the drought.

Figure 3-9. Spring 2019 Principal Aquifer Groundwater Elevation Contours

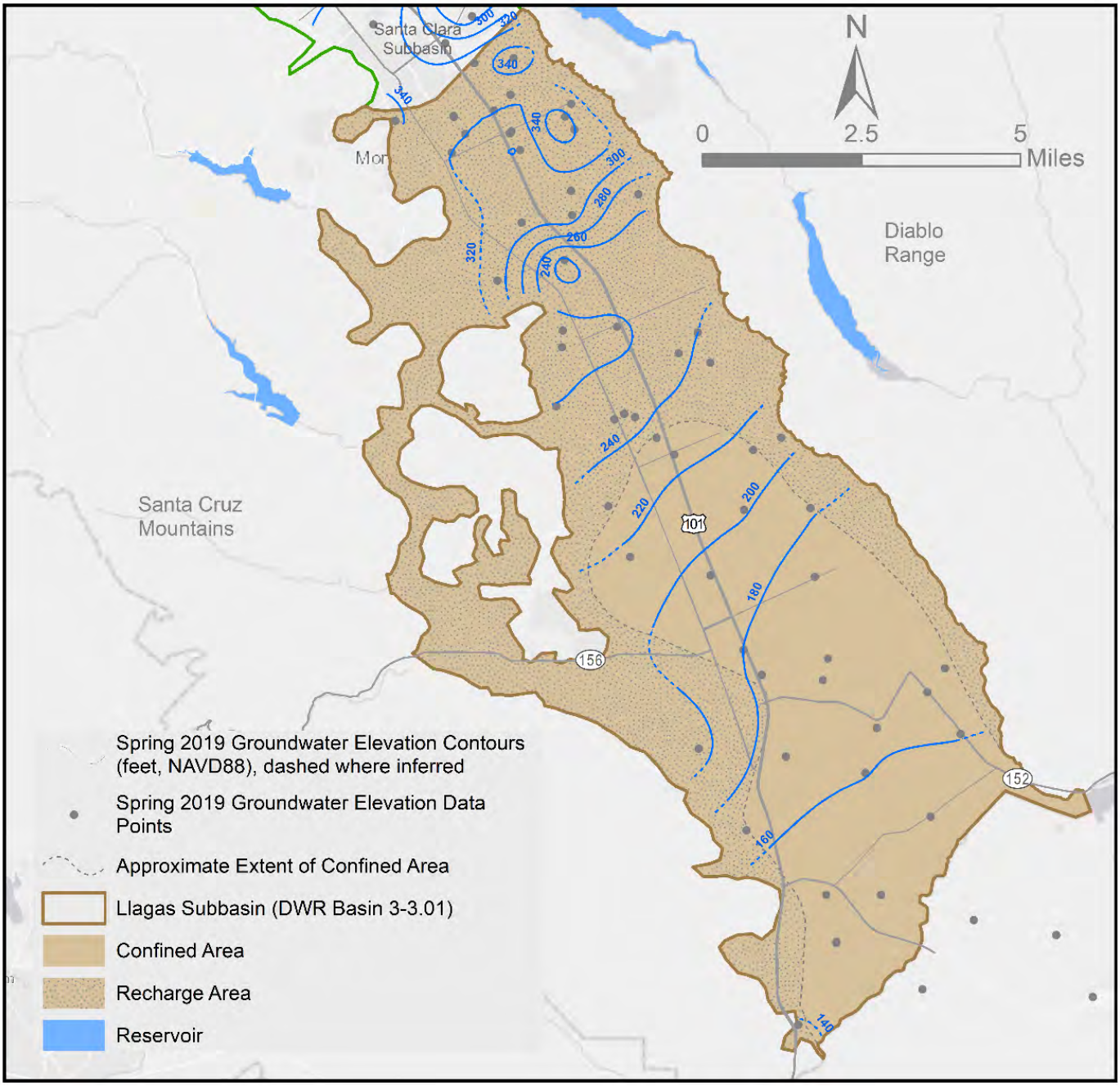
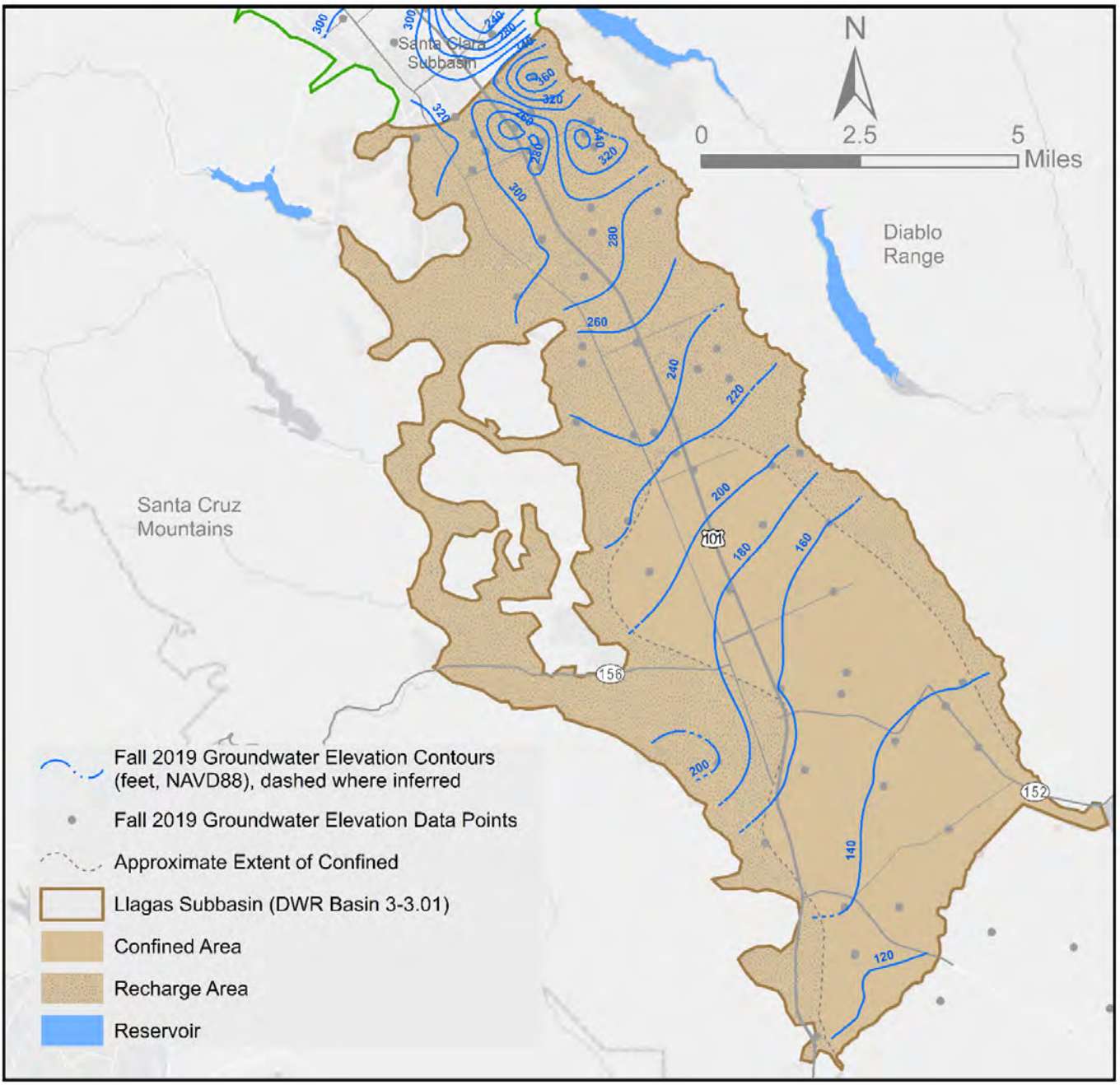


Figure 3-10. Fall 2019 Principal Aquifer Groundwater Elevation Contours



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3.2.2 Land Subsidence

Inelastic land subsidence has not been observed in the Llagas Subbasin. Valley Water partnered with U.C. Berkeley researchers to use satellite imagery (InSAR) to evaluate the potential for subsidence in the Llagas Subbasin.[60] Using satellite imagery from 1992 to 2000, they concluded that there was no evidence of long-term subsidence. Seasonal ground surface movement was observed; rising and lowering by the same amount between the wet and dry seasons.

3.2.3 Surface Water and Groundwater Interaction

Valley Water's managed recharge program includes significant recharge through many miles of stream channels over the recharge area, indicating groundwater and surface water generally are disconnected in these reaches. As described further below, the managed recharge program helps to maintain flows in these creeks, most of which would flow only intermittently otherwise. Valley Water is not aware of any areas where groundwater pumping has a significant or unreasonable effect on interconnected surface water.

Valley Water has a comprehensive surface water monitoring network to measure creek flows, comply with water rights reporting and reservoir restrictions, and meet environmental requirements. Stream gauging by Valley Water is discussed in Chapter 7. Surface water flow data can be used to evaluate which reaches of streams are gaining or losing streams with regard to groundwater.

The portions of the Llagas Subbasin that are most likely to have surface water/groundwater interaction can be inferred through historical ecology maps prepared by the SFEI and the depth to shallow groundwater.[61] Figure 3-11 shows the historical ecology, including wetlands, marshes, and willow groves that may be associated with shallow groundwater.[62] Some of these areas may have been present due to poorly draining soils rather than surface water/groundwater interaction. It is also important to note that this was the historical distribution prior to development and does not represent current or even recent conditions. The Uvas-Carnadero wetlands are located in the southwestern corner of the Llagas Subbasin. This area is the exit for all groundwater flowing towards San Benito County. Groundwater upwells in this area and maintains the wetlands. Along the southeast side of the Llagas Subbasin in the Soap Lake area is another large area of wetlands. The wetlands in this area are believed to be primarily due to flooding and poorly draining soils.

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[60] Bürgmann and Johanson, South County Subsidence Study – Phase I and Phase II, University of California, Berkeley, 2005.
[61] SCVWD, GIS Coverage of Depth to First Groundwater, 2003.
[62] Grossinger et al., South Santa Clara Valley Historical Ecology Study, including Soap Lake, the Upper Pajaro River, and Llagas, Uvas-Carnadero, and Pacheco Creeks, 2008.

Figure 3-11. Llagas Subbasin Historical Ecology

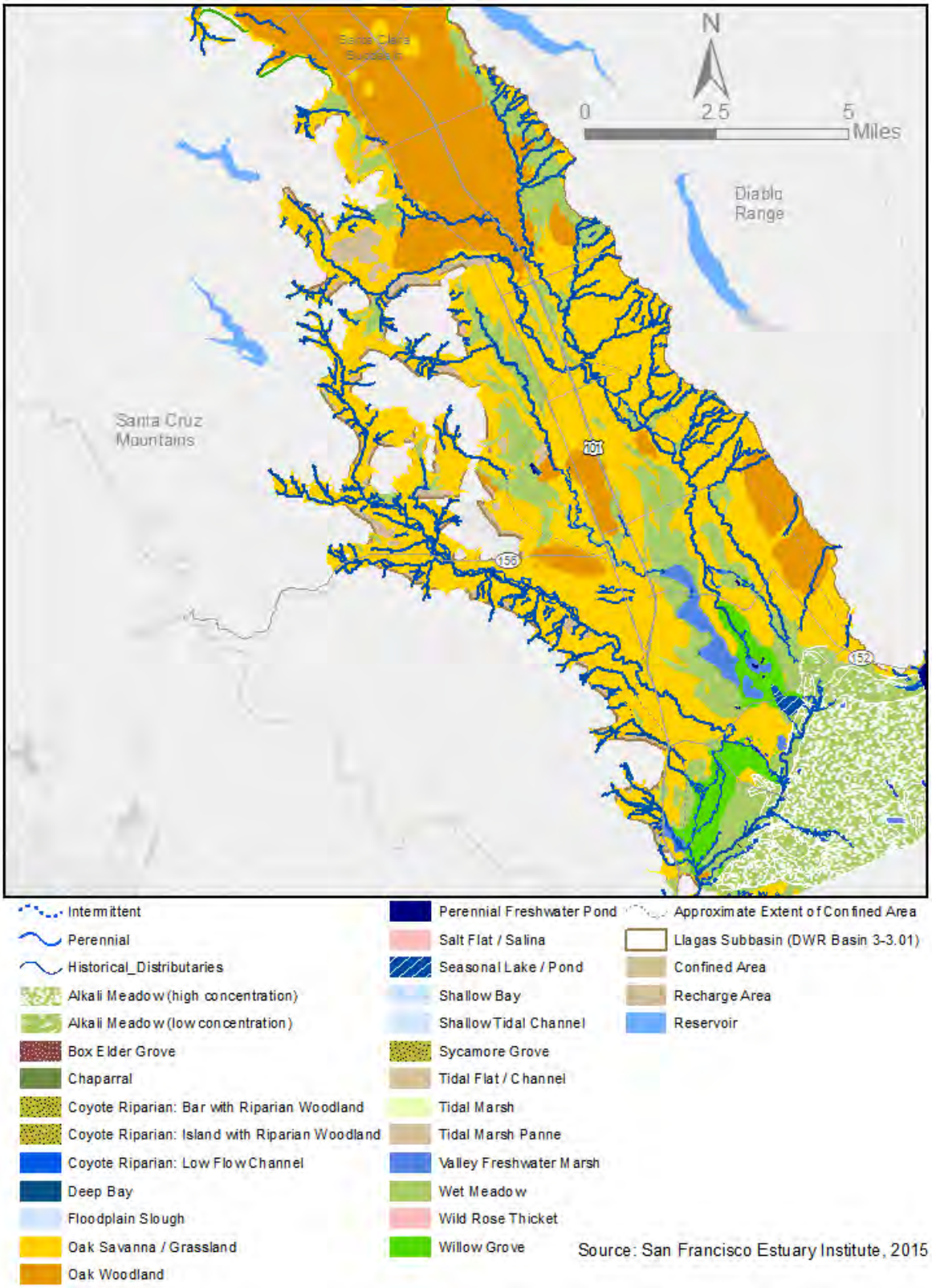
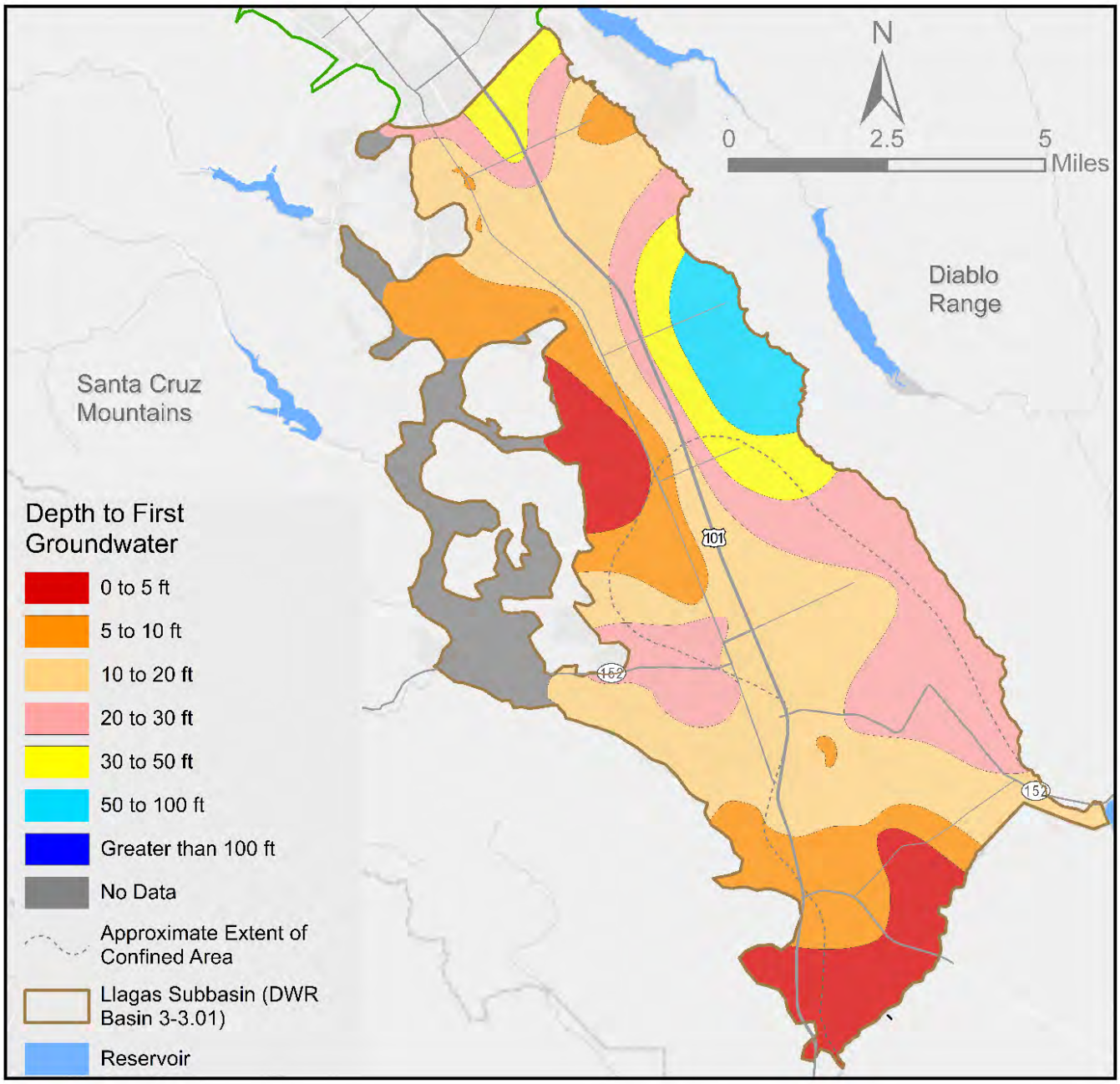


Figure 3-12 is a generalized depth to first groundwater map in the Llagas Subbasin based on data primarily from contaminant release sites. This map reflects the shallowest groundwater encountered based on available historical water level data from 1978 to 2019, rather than a specific point in time. The data was compiled from the State Water Resources Control Board GeoTracker database and from Valley Water's monitoring programs. Areas exhibiting shallow groundwater would be more likely to have surface water/groundwater interaction and gaining stream reaches.

Figure 3-12. Depth to First Groundwater in the Llagas Subbasin



3.2.4 Groundwater Dependent Ecosystems

As noted previously, under SGMA, GDEs are "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351(m)). GDEs in California include a wide range of natural communities, including wetlands, rivers, streams, and estuaries, seeps and springs, and terrestrial vegetation. GDEs also include deep-rooted plants or plant communities that obtain water from the water table (called phreatophytes). A detailed technical memorandum that documents the current understanding, approach, and methods used to identify and map GDEs is included in Appendix G.

GDEs in the Llagas Subbasin are shown in Figure 3-13. This map was created by generally following The Nature Conservancy GDE guidance document[63]. Figure 3-13 is based on all California phreatophytes and identifies GDEs as likely (depth to water (DTW) less than 30 feet), transition (DTW 30 to 50 feet), and possible (DTW unknown). The DTW shown in Figure 3-13 was created using the median water level data between 2010 and 2019 from 117 wells in the Llagas Subbasin and a 30 ft LIDAR land surface elevation dataset. It is important to note that the large scale DTW map in Figure 3-13 appears to incorrectly identify some GDEs based on DTW. However, at a zoomed-in map scale, all GDEs are correctly mapped based on DTW categories, as explained in Appendix G. Appendix G also presents the results of 34 field assessments performed by Valley Water biologists and describes how those results were extrapolated and used with DTW to delineate GDEs. The GDE maps presented in the 2021 GWMP will be revised and updated as new information becomes available during each five-year Alternative Plan update cycle.

Figure 3-13 indicates that most of the GDEs in the Llagas Subbasin are along stream reaches. Most of these stream reaches are losing reaches and are actively used in Valley Water's managed in-stream recharge operations. These operations rely on natural streamflow and operational releases from Valley Water's local reservoirs and provide nearly perennial flows during many years in losing stream reaches that were historically ephemeral (intermittent) streams prior to Valley Water's operations. The reservoir releases have created nearly perennial flow in losing streams that are disconnected from the regional water table, and thus are not interconnected surface water or GDEs. Figure 3-13 does not include phreatophytes overlying DTW greater than 50 feet because the DTW exceeds rooting depths. Many reaches downstream of reservoirs overlie likely and transition DTW categories and contain GDEs that are supported by both surface water augmented flows and groundwater. Therefore, some GDEs in Figure 3-13 are supported solely by groundwater and others are supported by a combination of surface water and groundwater. Because indicator phreatophytes are essentially identical along these reaches, it is very difficult to distinguish between the GDEs that are support by groundwater only and those supported by a combination of surface water and groundwater.

The Llagas Subbasin has a total of 3,047 acres of GDEs, including 1,600 acres of likely GDE, 107 acres of transition, and 1,340 acres of possible GDE (Table 3-1). To be consistent with the TNC GDE guidance, in areas where DTW is unknown, possible GDE were identified to reflect phreatophytes located in areas of unknown DTW (Figure 3-13). While DTW is mapped across most areas of the subbasins, there are some small areas where groundwater elevation data is unavailable, including the western areas of the Llagas Subbasin (Figure 3-13). Specifically, the narrow canyon areas along the western edge of the Llagas Subbasin are not currently part of Valley Water's groundwater level monitoring program because these areas were historically considered part of the bedrock terrain. Therefore, groundwater elevation data is unavailable to map DTW in these areas. The Llagas Subbasin has a relatively high percentage of possible GDEs, which supports the need for future evaluations of DTW in areas of possible GDEs (Figure 3-13) to confirm if those phreatophytes are GDEs (Appendix G).

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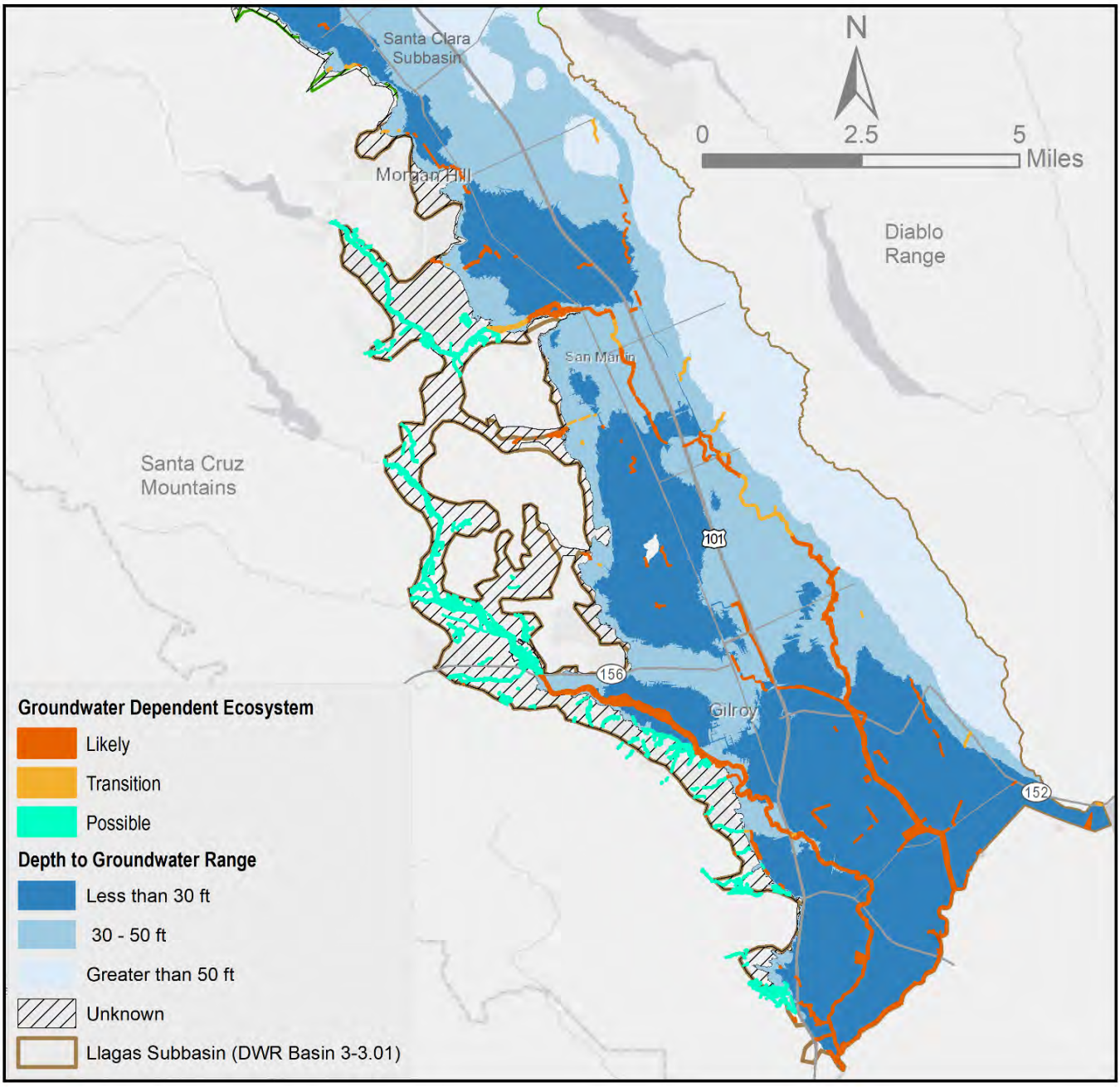
[63] Rohde, M. M., S. Matsumoto, J. Howard, S. Liu, L. Riege, and E. J. Remson. 2018. Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans. The Nature Conservancy, San Francisco, California, 93 pages, available here: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_1-31-18.pdf

Figure 3-13. Groundwater Dependent Ecosystems in the Llagas Subbasin



As explained in Chapter 4, the Llagas Subbasin has sustainable groundwater supply conditions. In the very southern areas of the Llagas Subbasin, where flowing artesian conditions exist in winter, groundwater pumping from the principal aquifer zone is effectively disconnected from the shallow water table and is not expected to affect GDEs. As explained in Appendix G, most GDEs in the recharge (unconfined) areas of the Llagas Subbasin are along losing stream reaches that are disconnected from the regional water table and thus are not considered interconnected surface water. Because these losing stream reaches are not interconnected and streamflow is supported by natural runoff and in-stream recharge operations via reservoir releases, GDEs are generally not affected by groundwater

pumping in the recharge areas or the central portion of the Llagas Subbasin. Long-term groundwater levels are stable and demonstrate sustainable groundwater conditions (Chapter 4). Droughts of limited duration may suppress the shallow water table, but effects to GDEs are expected to be minimal with continued management activities. Subsequent chapters of the GWMP describe Valley Water's extensive groundwater monitoring networks and comprehensive groundwater management activities that will continue to ensure groundwater sustainability in the Llagas Subbasin that help support GDEs.

Table 3-2. Groundwater Dependent Ecosystem Area in the Llagas Subbasin

GDE category	Llagas Subbasin (acres)
Likely GDE	1,600
Transition	107
Possible GDE	1,340
Total (acres)	**3,047**

3.2.5 Groundwater Quality

Valley Water has monitored and evaluated groundwater quality in the Llagas Subbasin for decades, with regular testing since the late 1980s when management responsibilities were transferred to Valley Water. Water quality data presented and summarized in this section represents data collected by Valley Water and other agencies from 2010 to 2019. The primary source for data collected by other agencies is compliance sampling for public water supply wells submitted by water retailers to the State DDW. Valley Water's groundwater monitoring and evaluation allows for an appraisal of current conditions and offers a consistent basis for detecting near-term and long-term trends.

The Llagas Subbasin generally produces groundwater of good quality that does not need treatment beyond disinfection at public water supply wells. However, the presence of elevated nitrate is an ongoing groundwater protection challenge, as presented in Figure 3-14. Like Coyote Valley, except for the City of Gilroy, the Llagas Subbasin is largely rural and agricultural, with ongoing nitrate sources including synthetic fertilizers and septic systems. The 2010 to 2019 median nitrate concentration was 5.3 mg/L (as N) and concentration trends in Llagas remain relatively stable or decreasing.

Historically, the presence of perchlorate was also of concern. However, recent perchlorate concentrations in the principal aquifer are now stable or decreasing as large-scale remediation efforts continue at the former Olin Corporation site, the cleanup of which is overseen by the Central Coast Water Quality Control Board. Valley Water's managed aquifer recharge is also acknowledged as contributing to improved perchlorate conditions due to the replenishment of large volumes of water.

Figures 3-15 and 3-16 show the relative concentrations of inorganic parameters with health-based MCLs (including nitrate and perchlorate) and aesthetic-based SMCLs[64] for the period between 2010 and 2019 in the principal aquifer. Calcium, magnesium, and bicarbonate are the dominant dissolved water-quality parameters in the Llagas Subbasin. Variation from this includes groundwater with sodium bicarbonate and mixed cation-mixed anion character. The principal aquifer zone median TDS concentration was 404 mg/L in 2019.

Summary statistics for the Llagas Subbasin shallow and principal aquifer zones between 2010 and 2019 are

[64] Maximum Contaminant Levels are health-based drinking water standards established by the California Division of Drinking Water or U.S. Environmental Protection Agency. Secondary MCLs are aesthetic-based standards established by these agencies to address aesthetic issues such as taste and odor. Figures 3-15 and 3-16 show only those inorganic parameters detected in moderate or high concentrations relative to the MCL or SMCL.

presented in Tables 3-2 through 3-5. Tables 3-2 and 3-3 present summary statistics for all inorganic water-quality parameters. Tables 3-4 and 3-5 present the organic chemicals detected in the shallow and principal aquifers, respectively. Although some organic chemicals are detected in the Llagas Subbasin, detections are infrequent and are typically low concentrations.

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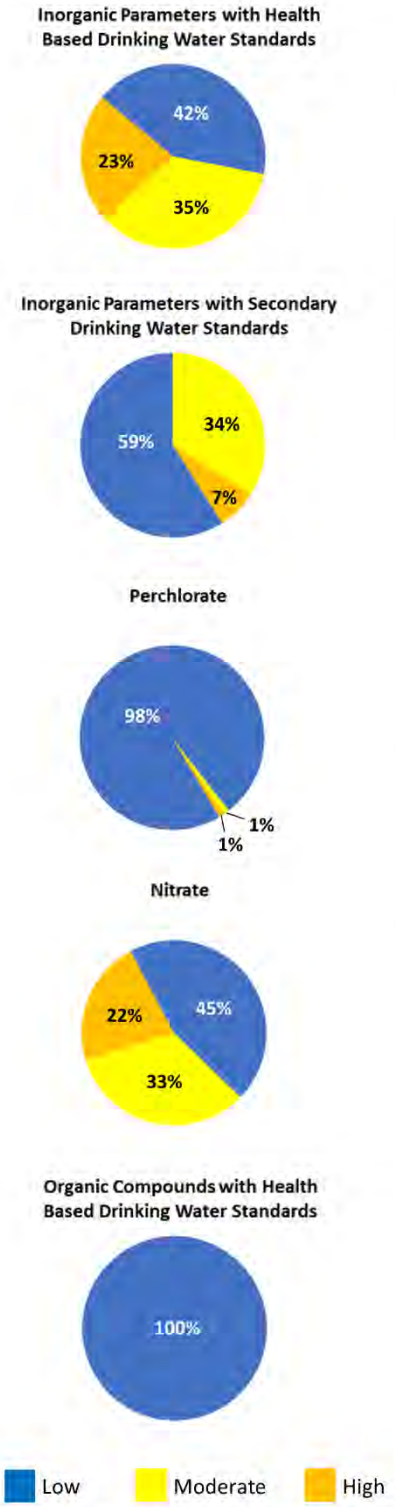
Figure 3-14. Llagas Subbasin Principal Aquifer Water Quality Overview (2010–2019)



High: greater than the MCL, SMCL, or upper SMCL threshold
Moderate: greater than 1/2 the MCL or SMCL, or above the recommended SMCL threshold
Low: not detected, less than 1/2 the MCL or SMCL, or below the recommended SMCL threshold
Based on the most recent data from 2010-2019.

Inorganic Parameters

Inorganic parameters include trace elements (such as metals), major ions, nutrients, and radioactive parameters. Inorganic constituents are typically naturally occurring and can leach from rocks and sediments in contact with groundwater. Anthropogenic sources include industrial and manufacturing facilities.

Water quality in principal aquifers is generally good for inorganic parameters with respect to health-based Maximum Contaminant Levels (MCLs), with the exception of nitrate, which is described further below. Perchlorate was detected above the MCL in three wells sampled by Valley Water or public water suppliers.

While health-based drinking water standards have been established for many inorganic parameters, some constituents also have secondary MCLs (SMCL) based on their ability to affect the aesthetic properties of water through taste, color, odor, or by causing staining or scale formation. The SMCL for these parameters may be a single value, or a range, with a lower (recommended) and upper threshold. As shown on the left, inorganic parameters with aesthetic-based standards are found in high concentrations in 7% of the principal aquifer, and in moderate concentrations in 34% of the aquifer. Iron, manganese, TDS, and specific conductance were detected above the SMCL.

Nitrate

Nitrate is naturally occurring in groundwater at low concentrations. However, anthropogenic sources such as fertilizers and septic systems have impacted groundwater quality in the Llagas Subbasin and many other areas of California. Nitrate was detected above the MCL over a wide area of the Llagas Subbasin due to historical and ongoing agricultural practices and use of septic systems. Nearly all detections of nitrate above the MCL occurred in domestic wells, which are not subject to regular testing or state drinking water standards. Valley Water works with local stakeholders and regulatory agencies to reduce nitrate loading to groundwater and to reduce well owner exposure to elevated nitrate in drinking water.

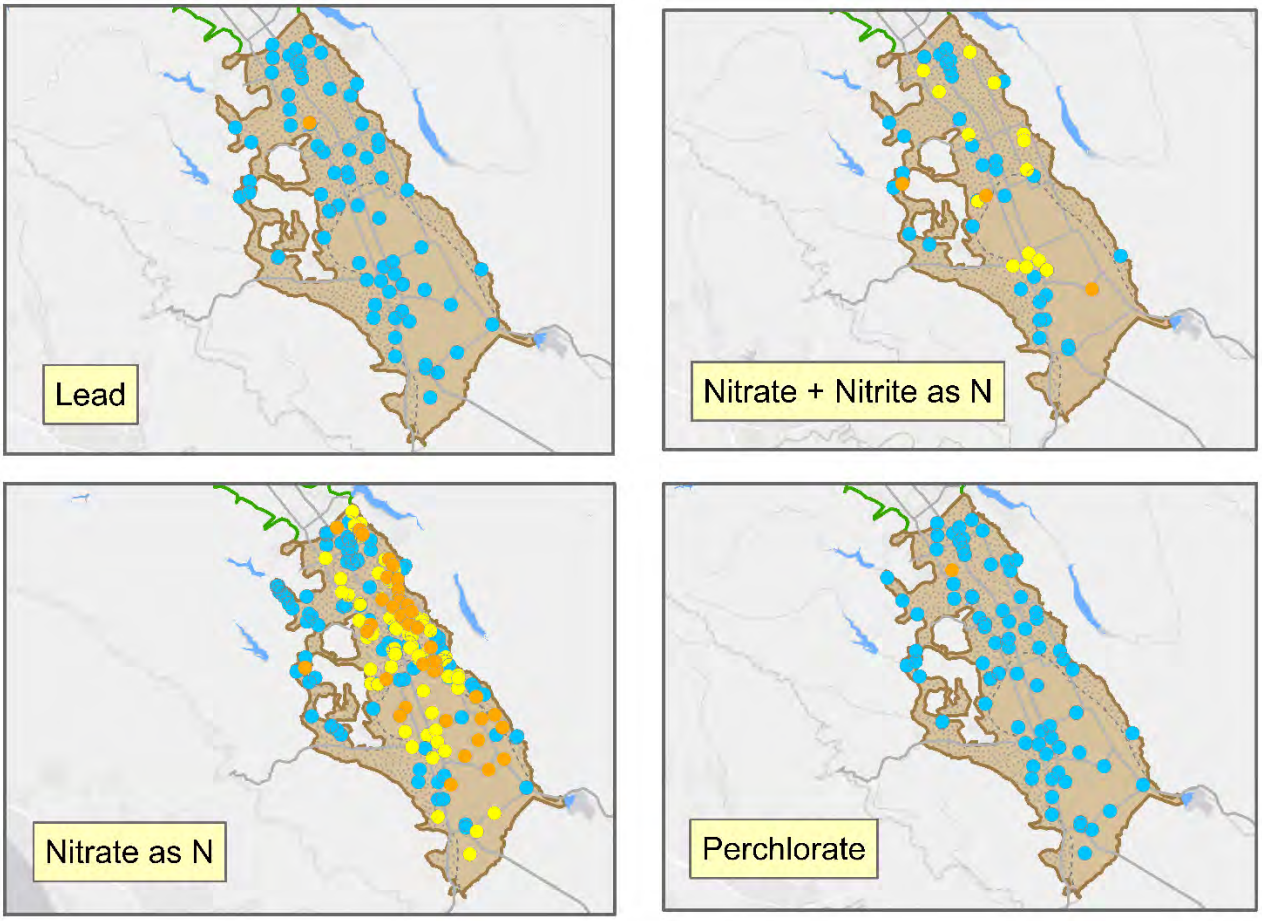
Perchlorate

The occurrence of perchlorate in the Llagas Subbasin from a former highway safety flare plant has been substantially reduced due to ongoing managed recharge, removal of perchlorate from the source area, and ongoing remediation efforts. The perchlorate plume, which once extended above ten miles from Morgan Hill to Gilroy, now extends approximately three miles to the San Martin Airport. Fewer than 10 domestic wells require treatment systems or replacement water.

Organic Compounds

Organic compounds include Volatile Organic Compounds (VOCs) and pesticides, and are present in many household, commercial, and industrial products. As shown on the left, groundwater quality in the principal aquifer zone is excellent with respect to organic compounds. There were localized detections of some VOCs in the Llagas Subbasin, but none exceeding half the MCL.

Figure 3-15. Llagas Subbasin Principal Aquifer Concentrations Relative to Primary Drinking Water Standards (2010–2019)



Relative Concentration

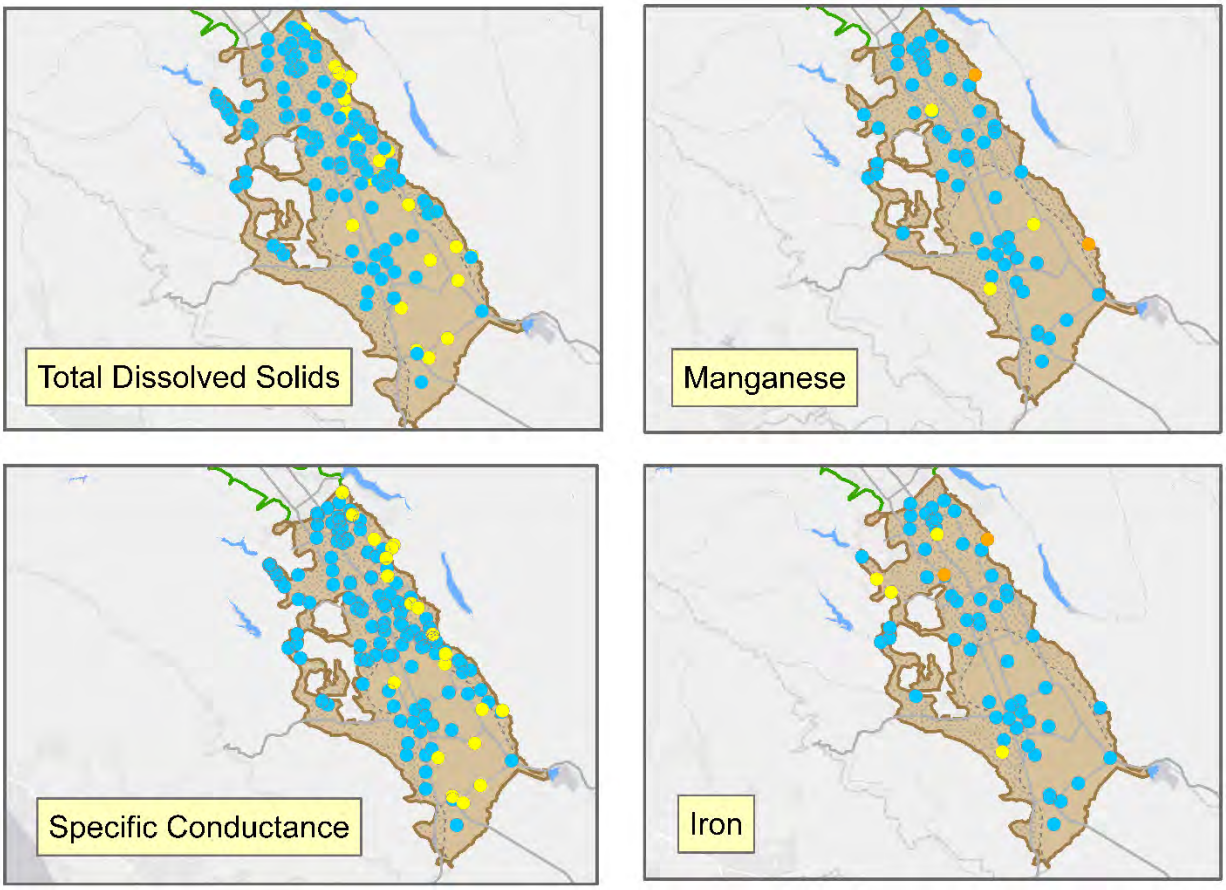
- High: greater than the MCL
- Moderate: greater than 1/2 the MCL
- Low: not detected, less than 1/2 the MCL

0 4 8 16 Miles

N

Notes:
Based on most recent results from 2010 to 2019.
Maps include constituents with at least one Moderate detection.

Figure 3-16. Llagas Subbasin Principal Aquifer Concentrations Relative to Secondary Drinking Water Standards (2010–2019)



Relative Concentration

- High: greater than the SMCL or upper SMCL threshold
- Moderate: greater than 1/2 the MCL, or above the recommended SMCL threshold
- Low: not detected, less than 1/2 the SMCL, or below the recommended SMCL threshold

0 4 8 16 Miles

N

Notes:
Based on most recent results from 2010 to 2019.
Maps include constituents with at least one Moderate detection.

Table 3-2. Llagas Subbasin Shallow Aquifer Zone Water Quality Summary (2010–2019)

Parameter[1]	MCL[2]	SMCL	Number of Wells Tested	Results[4]		
				50th Percentile (median)	95th Percentile	IQR
Aluminum (µg/L)	1,000	200	23	17	66	20
Antimony (µg/L)	6	-	23	<1	<1	-
Arsenic (µg/L)	10	-	23	<2	<2	-
Barium (µg/L)	1,000	-	23	113	356	112
Beryllium (µg/L)	4	-	23	<1	<1	-
Bicarbonate (as HCO3) (mg/L)	-	-	23	233	422	126
Boron (µg/L)	-	-	23	108	271	83.5
Bromide (mg/L)	-	-	50	0.06	0.4	0.1
Cadmium (µg/L)	5	-	23	<1	<1	-
Calcium (mg/L)	-	-	23	60	101	34
Calcium (as CaCO3) (mg/L)	-	-	23	150	252	85
Chloride (mg/L)	-	250[3]	23	49	165	37
Chromium (µg/L)	50	-	23	1	7	-
Chromium 6 (Hexavalent) (µg/L)	-	-	17	<1	3	-
Cobalt (µg/L)	-	-	23	<1	<1	-
Copper (µg/L)	1,300	1,000	23	1	6	2
Fluoride (natural source) (mg/L)	2	-	50	0.08	0.2	-
Iron (µg/L)	-	300	23	7	99	18
Lead (µg/L)	15	-	23	<2	<2	-
Lithium (µg/L)	-	-	23	8	29	18
Magnesium (mg/L)	-	-	23	38	70	27
Manganese (µg/L)	-	50	23	2	118	11
Mercury (µg/L)	2	-	22	<1	<1	-
Molybdenum (µg/L)	-	-	23	<1	<1	-
Nickel (µg/L)	100	-	23	1	11	2
Nitrate (as N) (mg/L)	10	-	50	5.3	28	9.2
Orthophosphate (as PO4) (mg/L)	-	-	51	0.05	0.2	-
Perchlorate (µg/L)	6	-	23	<4	<4	-
Potassium (mg/L)	-	-	23	1	2	0.5
Selenium (µg/L)	50	-	23	<5	<5	-
Silica (mg/L)	-	-	23	28	55	9.5
Silver (µg/L)	-	100	23	<1	<1	-
Sodium (mg/L)	-	-	23	26	99	22
Specific Conductance (µS/cm)	-	900[3]	45	624	1,250	290
Sulfate (mg/L)	-	250[3]	50	32	111	26
Thallium (µg/L)	2	-	23	<1	<1	-
Total Dissolved Solids (mg/L)	-	500[3]	41	367	796	220

Turbidity, Field (NTU)	-	5	23	1	12	1
Vanadium (µg/L)	-	-	23	1	9	2
Zinc (µg/L)	-	5,000	23	<10	68	-

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Parameters analyzed in fewer than five wells are not included.

1. mg/L = milligrams per liter; µg/L = micrograms per liter; MFL = million fibers per liter; µS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units
2. Maximum Contaminant Level, or health-based drinking water standard, specified in Title 22 of the California Code of Regulations.
3. Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed.
4. For results with multiple reporting limits, the median, interquartile range (IQR), and 95th percentile were computed using the Maximum Likelihood Estimate (MLE) method.

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Table 3-3. Llagas Subbasin Principal Aquifer Zone Water Quality Summary (2010–2019)

Parameter[1]	MCL[2]	SMCL	Number of Wells Tested	Results[4]		
				50th Percentile (median)	95th Percentile	IQR
Aluminum (µg/L)	1,000	200	74	10	46	13
Antimony (µg/L)	6	-	74	<6	<6	-
Arsenic (µg/L)	10	-	74	<2	<2	-
Asbestos (MFL)	7	-	5	<0.2	<0.2	0
Barium (µg/L)	1,000	-	74	84	236	73
Beryllium (µg/L)	4	-	74	<1	<1	-
Bicarbonate (as HCO3) (mg/L)	-	-	64	229	399	103
Boron (µg/L)	-	-	26	98	202	58
Bromide (mg/L)	-	-	144	0.2	0.5	0.2
Cadmium (µg/L)	5	-	74	<1	<1	-
Calcium (mg/L)	-	-	65	50	91	11
Calcium (as CaCO3) (mg/L)	-	-	23	138	245	46
Chloride (mg/L)	-	250[3]	65	43	117	31
Chromium (µg/L)	50	-	74	2	5	-
Chromium 6 (Hexavalent) (ug/L)	-	-	76	<1	4	-
Cobalt (µg/L)	-	-	23	<1	<1	-
Copper (µg/L)	1,300	1,000	64	<50	<50	-
Cyanide (µg/L)	150	-	52	<100	<100	-
Fluoride (natural source) (mg/L)	2	-	182	0.1	0.2	0.2
Iron (µg/L)	-	300	65	20	897	162
Lead (µg/L)	15	-	74	<5	<5	-
Lithium (µg/L)	-	-	23	9	25	4
Magnesium (mg/L)	-	-	65	30	58	17
Manganese (µg/L)	-	50	64	2	43	7
Mercury (µg/L)	2	-	74	<1	<1	-
Molybdenum (µg/L)	-	-	23	<5	<5	-
Nickel (µg/L)	100	-	74	<1	6	-
Nitrate (as N) (mg/L)	10	-	202	5.6	19	6.3
Nitrate + Nitrite (as N) (mg/L)	10	-	54	4	15	4
Nitrite (as N) (mg/L)	1	-	65	<0.4	<0.4	-
Orthophosphate (as PO4) (mg/L)	-	-	137	0.05	0.3	0.07
Perchlorate (µg/L)	6	-	82	<4	<4	-
Potassium (mg/L)	-	-	49	1	2	0.5
Selenium (µg/L)	50	-	74	<5	<5	-
Silica (mg/L)	-	-	25	28	49	7.6
Silver (µg/L)	-	100	64	<10	<10	-
Sodium (mg/L)	-	-	65	27	102	15
Specific Conductance, Field (µmhos/cm)	-	900[3]	151	613	1,057	244

Sulfate (mg/L)	-	250[3]	172	35	66	17
Thallium (µg/L)	2	-	74	<1	<1	-
Total Dissolved Solids (mg/L)	-	500[3]	138	383	665	145
Turbidity, Field (NTU)	-	5	64	0.5	4	0.8
Vanadium (µg/L)	-	-	23	<3	11	-
Zinc (µg/L)	-	5,000	64	<50	104	-

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the California Division of Drinking Water (DDW). The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Parameters analyzed in fewer than five wells are not included.

1. mg/L = milligrams per liter; µg/L = micrograms per liter; MFL = million fibers per liter; µS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units
2. Maximum Contaminant Level, or health-based drinking water standard, specified in Title 22 of the California Code of Regulations.
3. Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed.
4. For results with multiple reporting limits, the median, interquartile range (IQR), and 95th percentile were computed using the Maximum Likelihood Estimate (MLE) method.

Table 3-4. Llagas Subbasin Shallow Aquifer Zone Organic Parameter Detections (2010–2019)

Parameter	Units[1]	Primary MCL	Wells Tested	Percent of Wells Tested with Detection (%)	Maximum Concentration
1,1,1-Trichloroethane	µg/L	200	22	5	0.8
Chloroform (THM)	µg/L	-	22	9	17.8
Methyl Tert-Butyl Ether (MTBE)	µg/L	13	22	5	0.7
n-Nitrosodiethylamine (NDEA)	µg/L	-	20	5	6.4
n-Nitrosodi-n-Butylamine (NDBA)	µg/L	-	20	10	2.6

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the CA Division of Drinking Water (DDW). The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Parameters analyzed in fewer than five wells are not included. Of the 116 organic parameters tested in the shallow aquifer, 106 were not detected.

1. µg/L = micrograms per liter; ng/L = nanograms per liter

Table 3-5. Llagas Subbasin Principal Aquifer Zone Organic Parameter Detections (2010–2019)

Parameter	Units[1]	Primary MCL	Wells Tested	Percent of Wells Tested with Detection (%)	Maximum Concentration
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	75	3	2.18
1,2-Dichloropropane	µg/L	5	75	1	1.1
Bromodichloromethane (THM)	µg/L	-	72	3	2.2
Bromoform (THM)	µg/L	-	72	6	3.6
Chloroform (THM)	µg/L	-	72	4	7.6
Chloromethane	µg/L	-	72	1	1.0
Dibromochloromethane (THM)	µg/L	-	72	3	3.3
n-Nitrosodi-n-Butylamine (NDBA)	µg/L	-	17	24	6.2
Tert-Butyl Alcohol (TBA)	µg/L	-	72	3	3.9
Tetrachloroethene	µg/L	5	75	4	3.5
Toluene	µg/L	150	75	1	20
Total Trihalomethanes	µg/L	80	5	80	9.7

Notes:
Table includes Valley Water monitoring data from monitoring and domestic wells and public water system data reported to the CA Division of Drinking Water (DDW). The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet. For parameters analyzed more than once at a given well over the 10-year period, the most recent data is used. Of the 105 organic parameters tested in the principal aquifer, 93 were not detected.
1. µg/L = micrograms per liter

3.2.6 Seawater Intrusion

There are no seawater bodies near the Llagas Subbasin. Therefore, no seawater intrusion has been observed and the subbasin is not vulnerable to seawater intrusion.

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CHAPTER 4 – WATER SUPPLIES, DEMANDS AND BUDGET

This section presents information on current water demands, supplies, and groundwater budget for the Santa Clara and Llagas subbasins, as well as future demands.

4.1 COUNTYWIDE WATER SUPPLY SOURCES

Santa Clara County has a diverse water supply portfolio, with sources including local surface water, natural groundwater, imported water, and recycled water.

4.1.1 Local Surface Water

Valley Water currently has 20 appropriative water rights licenses and one filed water right permit with the State Water Resources Control Board totaling over 227,000 acre-feet per year (AFY). Local rainfall runoff is captured in Valley Water's reservoirs and is sent to drinking water treatment plants or diverted downstream for groundwater recharge. The total storage capacity of Valley Water's reservoirs is about 166,000 AF (Table 4-1), though several are operating at restricted capacity due to seismic stability concerns. Table 4-1 summarizes reservoir capacities, restrictions, and impacts from restrictions.

Table 4-1. Santa Clara County Reservoir Capacities

Reservoir / Dam	Reservoir Capacity (Acre-feet)	DSOD Restricted Capacity (Acre-feet)	Restricted Capacity (%)	Year Completed	Use
Anderson**	89,278	2,280	3	1950	Groundwater recharge, Treated for drinking water
Coyote	22,541	11,843	53	1936	Groundwater recharge, Treated for drinking water
Almaden	1,555	1,443	93	1935	Groundwater recharge, Treated for drinking water
Calero	9,738	4,414	45	1935	Groundwater recharge, Treated for drinking water
Guadalupe	3,320	2,134	64	1935	Groundwater recharge
Stevens Creek	3,056	No restriction	N/A	1935	Groundwater recharge
Lexington	18,534	No restriction	N/A	1952	Groundwater recharge
Chesbro	7,967	No restriction	N/A	1955	Groundwater recharge
Uvas	9,688	No restriction	N/A	1957	Groundwater recharge
Vasona	463	No restriction	N/A	1935	Groundwater recharge
Total	166,140	62,362			

Note - Capacities above reflect most current survey results.
** Pursuant to the Federal Energy Regulatory Commission (FERC) Directive, Anderson Reservoir is required to be lowered to 488 feet (in the North American Vertical Datum of 1988 (NAVD 88) starting on October 1, 2020.

Most of the reservoirs are sized for annual operations, storing water in winter for use in summer and fall. The exception is the Anderson-Coyote reservoir system, which historically provided valuable carryover of supplies from year to year and served as backup system to Valley Water's water treatment plants when imported water deliveries are curtailed. In addition, San Jose Water Company and Stanford University have surface water rights that contribute to local surface water availability for their customers.

4.1.2 Groundwater

The groundwater subbasins provide multiple benefits to residents and businesses in Santa Clara County. Although most of the groundwater pumped is sustained by Valley Water's managed recharge programs, the subbasins provide some groundwater supply resulting from the percolation of rainfall in the recharge areas and natural seepage through local creeks and streams (natural groundwater recharge). In addition, the groundwater subbasins serve as an extensive conveyance network, allowing water to move from the recharge areas to individual groundwater wells. The groundwater subbasins also provide some natural filtration of surface water as it percolates through the soil and rock. Unlike surface water, most groundwater in the county can be used for drinking water without treatment. Lastly, the groundwater subbasins provide water storage, allowing water to be carried over from the wet season to the dry season and from wet years to dry years.

4.1.3 Imported Water

Valley Water imported water is conveyed through the Sacramento-San Joaquin Delta and then pumped and delivered to the county through the South Bay Aqueduct, which carries water from the SWP, and through the San Felipe Division, which brings in water from the federal CVP. Valley Water has a contract for 100,000 AFY from the SWP and a contract for 152,500 AFY from the CVP. The actual amount of water delivered is typically less than these contractual amounts and depends on hydrology, conveyance limitations, and environmental regulations. Between 2010 and 2019, average SWP and CVP deliveries were about 51,000 and 101,000 AFY, respectively. Supplemental imported water is acquired through transfers and exchanges as needed and available. In addition, Valley Water is able to put some imported water supplies into carryover and Semitropic Groundwater Bank for later withdrawal and use. Imported supplies are delivered to Valley Water's three drinking water treatment plants, groundwater recharge facilities, and raw water irrigation customers.

Eight retailers in the county have contracts with the SFPUC to receive water from the SFPUC Regional Water System. The eight retailers, considered to be wholesale customers of SFPUC, are the cities of Palo Alto, Mountain View, Sunnyvale, Santa Clara, San José, and Milpitas; Purissima Hills Water District; and Stanford University. In addition, NASA-Ames is considered a retail customer of SFPUC. Valley Water does not control or administer SFPUC supplies in the county, but this supply reduces the demands on Valley Water supplies.

4.1.4 Recycled and Purified Water

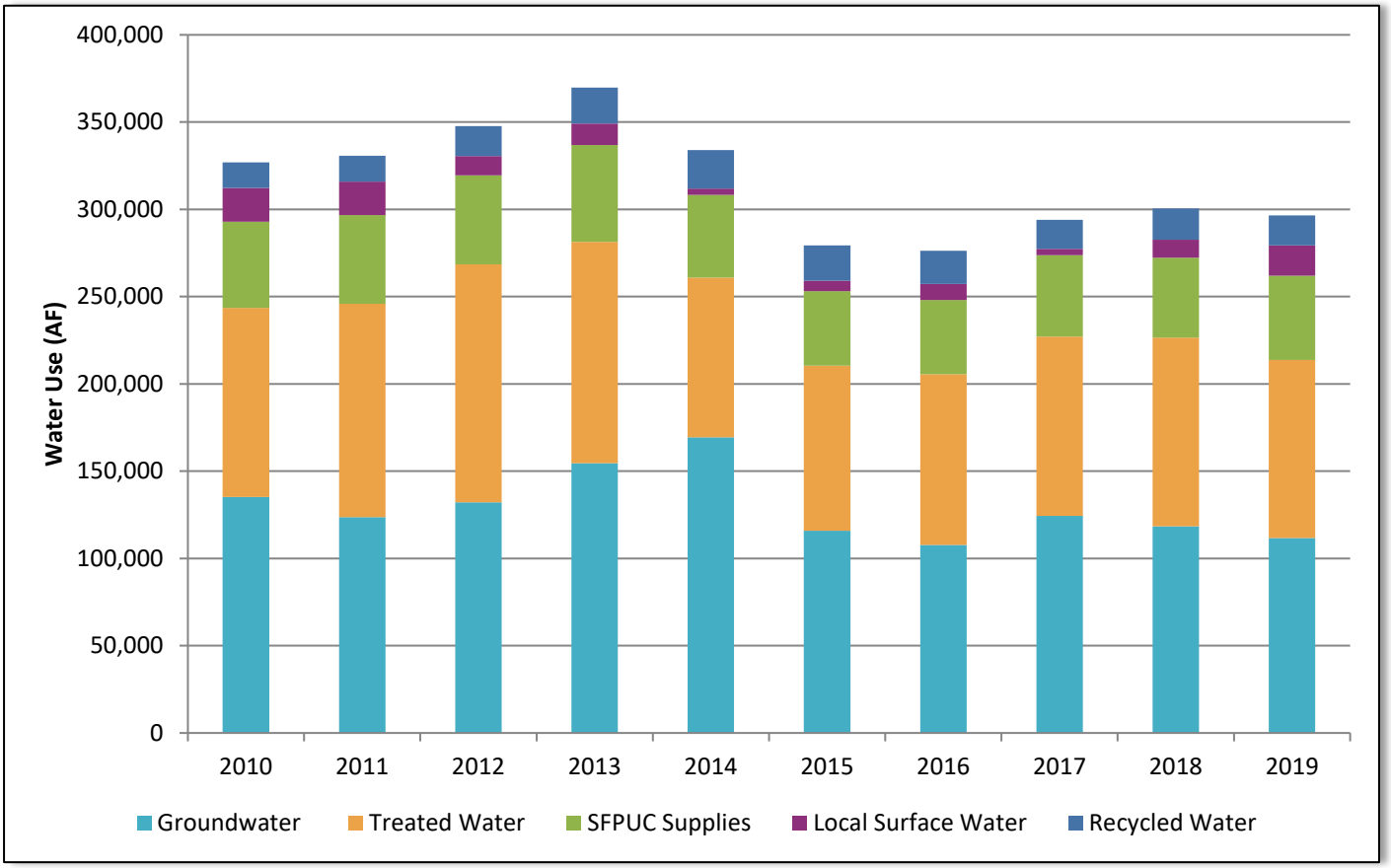
A growing source of water supply for Santa Clara County is recycled and purified water. Using recycled water helps augment water supplies through in-lieu recharge; provides a reliable, drought-proof, locally controlled water supply; and reduces reliance on imported water. Recycled water is currently about 6 percent (or about 17,000 AFY) of the county's supply and is distributed for non-potable uses such as landscape and agricultural irrigation, industrial cooling, and dual plumbed facilities. This recycled water is produced at the four wastewater plants in the county – Palo Alto, Sunnyvale, San Jose/Santa Clara, and South County Regional Wastewater Authority (SCRWA).

In addition, Valley Water is in the process of developing at least 11,000 AFY of potable reuse capacity. Valley Water is currently in the process of developing a countywide recycled and purified water master plan that will outline its approach to achieving its target - that recycled water, including both non-potable and potable reuse, is 10 percent of the county's water supply by 2025.

4.2 WATER USE

Annual countywide water use from 2010 to 2019 averages 315,600 acre-feet, with groundwater pumping, treated water deliveries, and SFPUC supplies accounting for about 91% of water used (Figure 4-1).

Figure 4-1. Countywide Water Use by Source (2010–2019)



4.3 CONJUNCTIVE WATER MANAGEMENT

Valley Water does not typically deliver groundwater to customers, although it does have some limited emergency groundwater pumping capacity. Instead, it manages the groundwater subbasins for the benefit of its groundwater customers and the county at large. Valley Water's water supply strategy since the 1930s has been to maximize conjunctive use, the coordinated management of surface and groundwater supplies, to enhance water supply reliability and avoid undesirable results like chronic overdraft, land subsidence, and seawater intrusion.

Local groundwater resources make up the foundation of the county's water supply, but they need to be augmented by Valley Water's comprehensive water management activities to reliably meet the needs of county residents, businesses, agriculture, and the environment. These activities include managed recharge of imported and local supplies and in-lieu groundwater recharge through the provision of treated surface water and raw water, acquisition of supplemental water supplies, and water conservation and recycling.

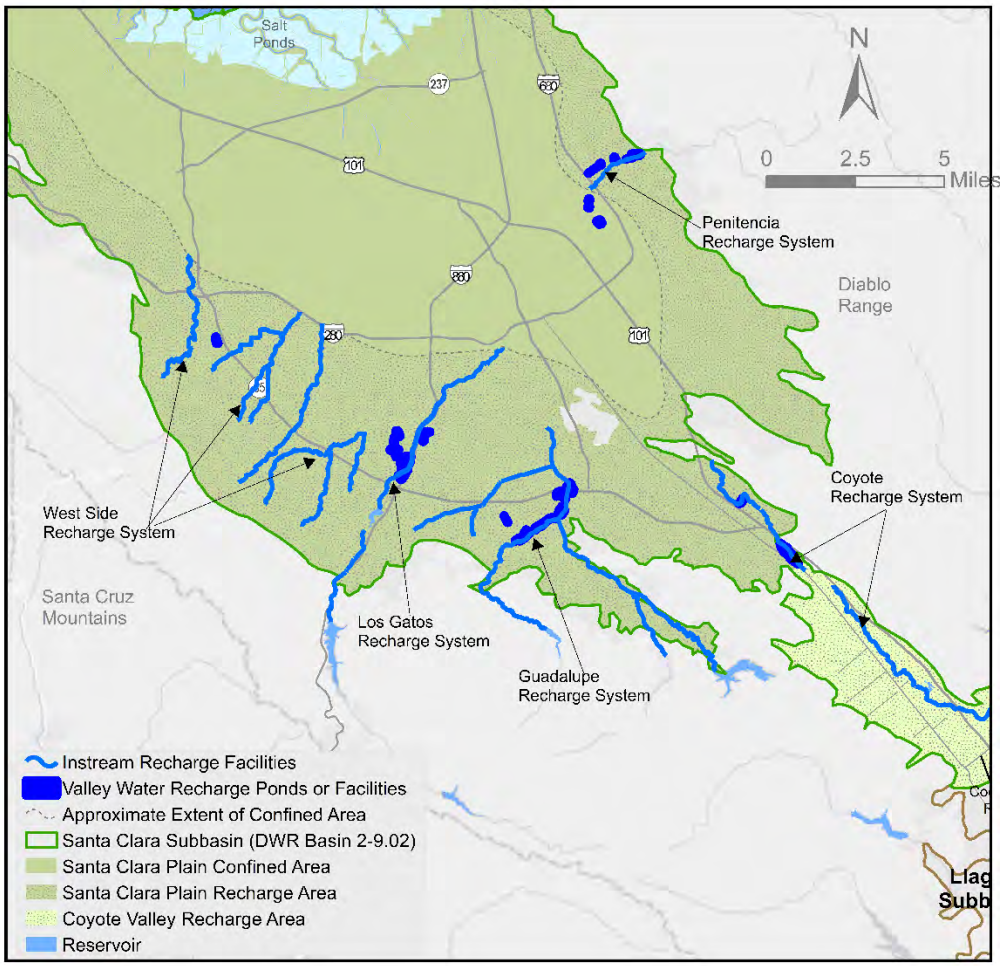
4.3.1 Managed Recharge

Valley Water's managed recharge program uses both surface water runoff captured in local reservoirs and imported water delivered by the raw water conveyance system to recharge groundwater through more than 277 acres[65] of recharge ponds and 91 miles of local creeks (Figure 4-2 and 4-3).

On average, Valley Water recharged 88,500 AF of local and imported water each year between 2010 and 2019. Managed recharge accounts for the majority of groundwater pumped in the county as shown in Figure 4-4. A detailed description of Valley Water's managed recharge facilities can be found in Appendix I.

Valley Water's managed recharge capacity is up to about 143,500 AFY (Appendix I). Maintaining Valley Water's managed recharge program requires ongoing operational planning for the distribution of local and imported water to recharge facilities; maintenance and operation of reservoirs, diversion facilities, distribution systems, and recharge ponds; and the maintenance of water supply contracts, water rights, and relevant environmental clearance.

Figure 4-2. Managed Recharge Facilities in the Santa Clara Subbasin



[65] Valley Water operates 102 managed recharge ponds (Appendix I) with a total water surface area of approximately 277 acres.

Figure 4-3. Managed Recharge Facilities in the Llagas Subbasin

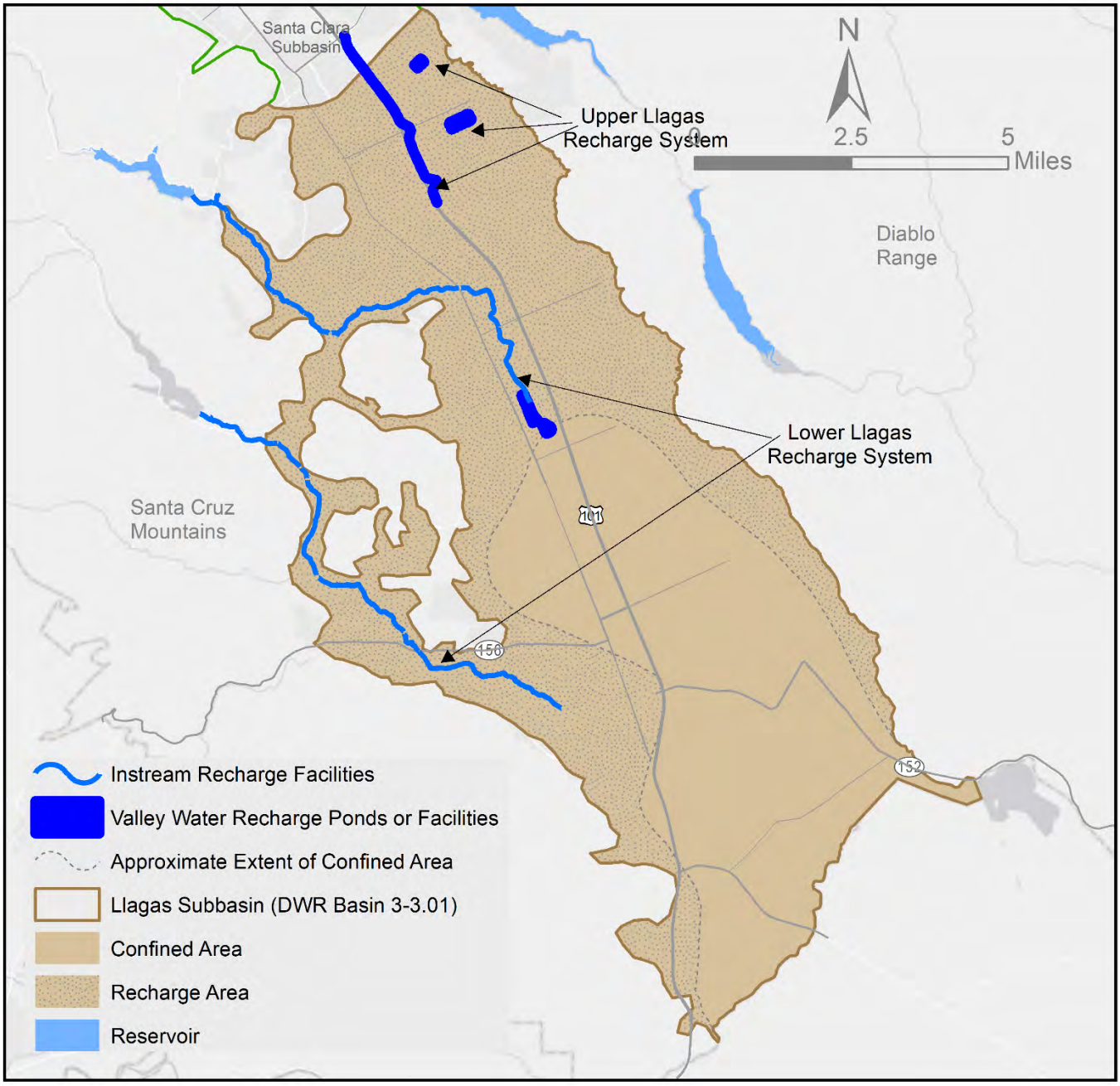


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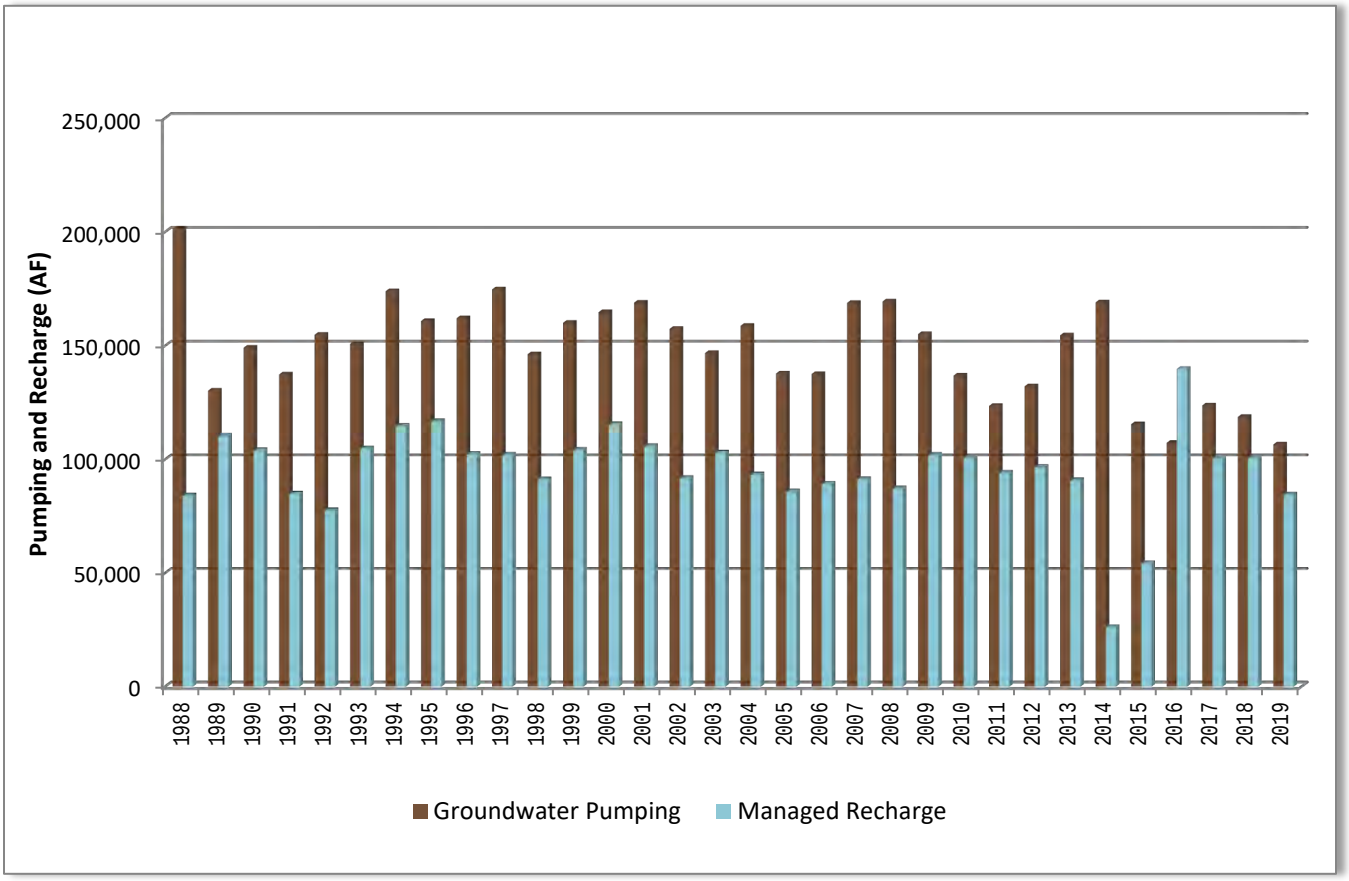
Figure 4-4. Countywide Groundwater Pumping and Managed Recharge



4.3.2 In-Lieu Recharge

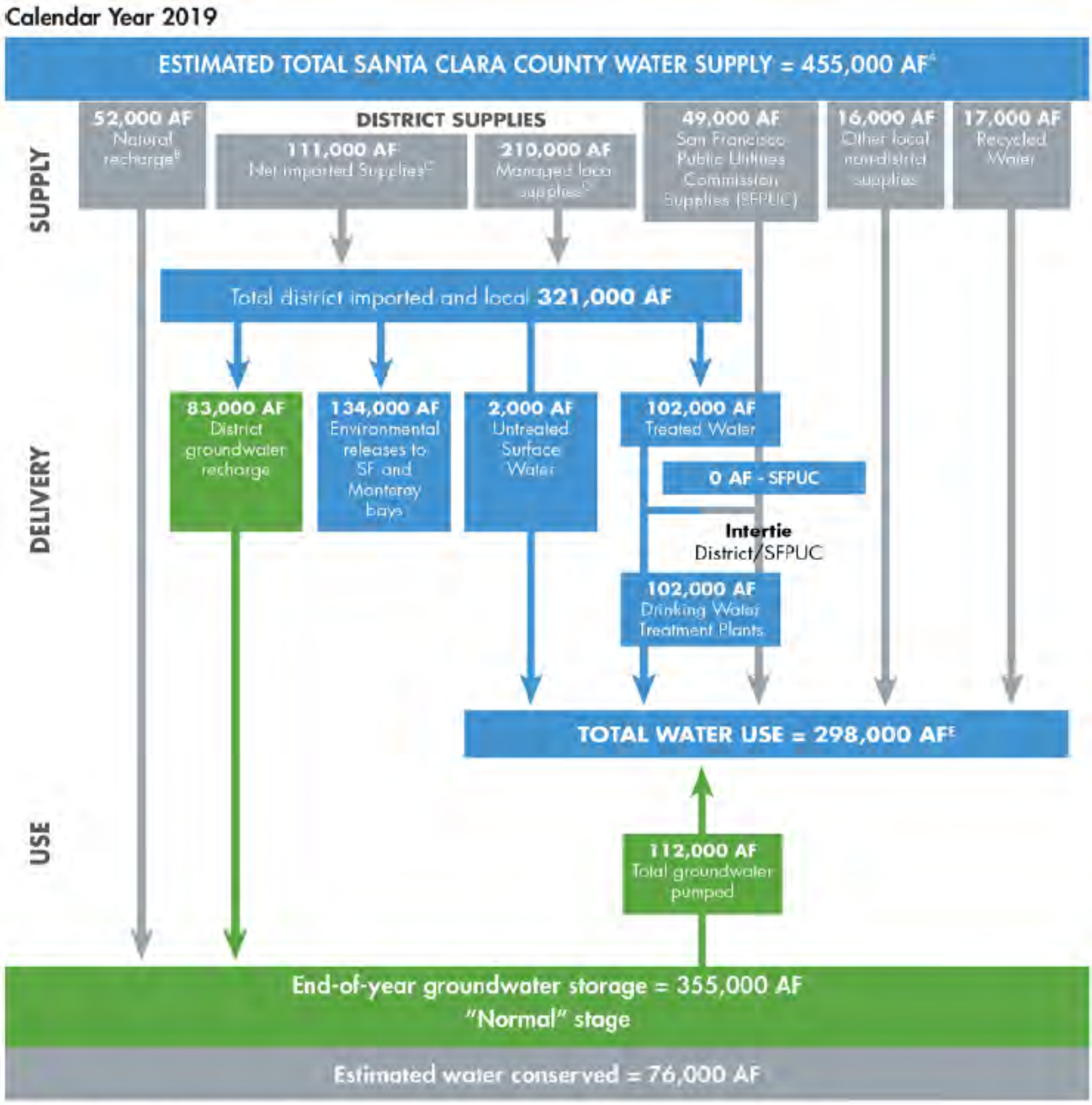
Just as important as direct replenishment through managed recharge are in-lieu recharge programs, including treated water deliveries, water recycling, and water conservation. These activities help maintain groundwater levels and storage by reducing groundwater pumping demands. By meeting demands that would otherwise be met by groundwater, these programs provide in-lieu recharge as if the groundwater subbasins had been recharged by that amount.

Valley Water owns and operates three drinking water treatment plants, distributing treated surface water to 7 of the 13 water retailers in the Santa Clara Plain. Combined, Valley Water treatment plants have a processing rate of over 200 million gallons per day, with treated water deliveries up to 136,000 AFY in a normal year. SFPUC deliveries to several retailers and surface water delivered by Valley Water, San Jose Water Company, and Stanford University also reduce the need for pumping.

Valley Water encourages recycled water development in the county through partnerships with the four local wastewater agencies and through technical assistance. An estimated 17,000 AF of recycled water was used in 2019 (Figure 4-5), offsetting demands that might otherwise have been met through other potable supplies such as additional groundwater pumping. Similarly, in 2019, Valley Water's water conservation program saved an estimated 76,000 AF of water[66].

[66] FY 20-21 Protection and Augmentation of Water Supplies Report (Valley Water, 2020)

Figure 4-5. Santa Clara County Supplies and Water Use



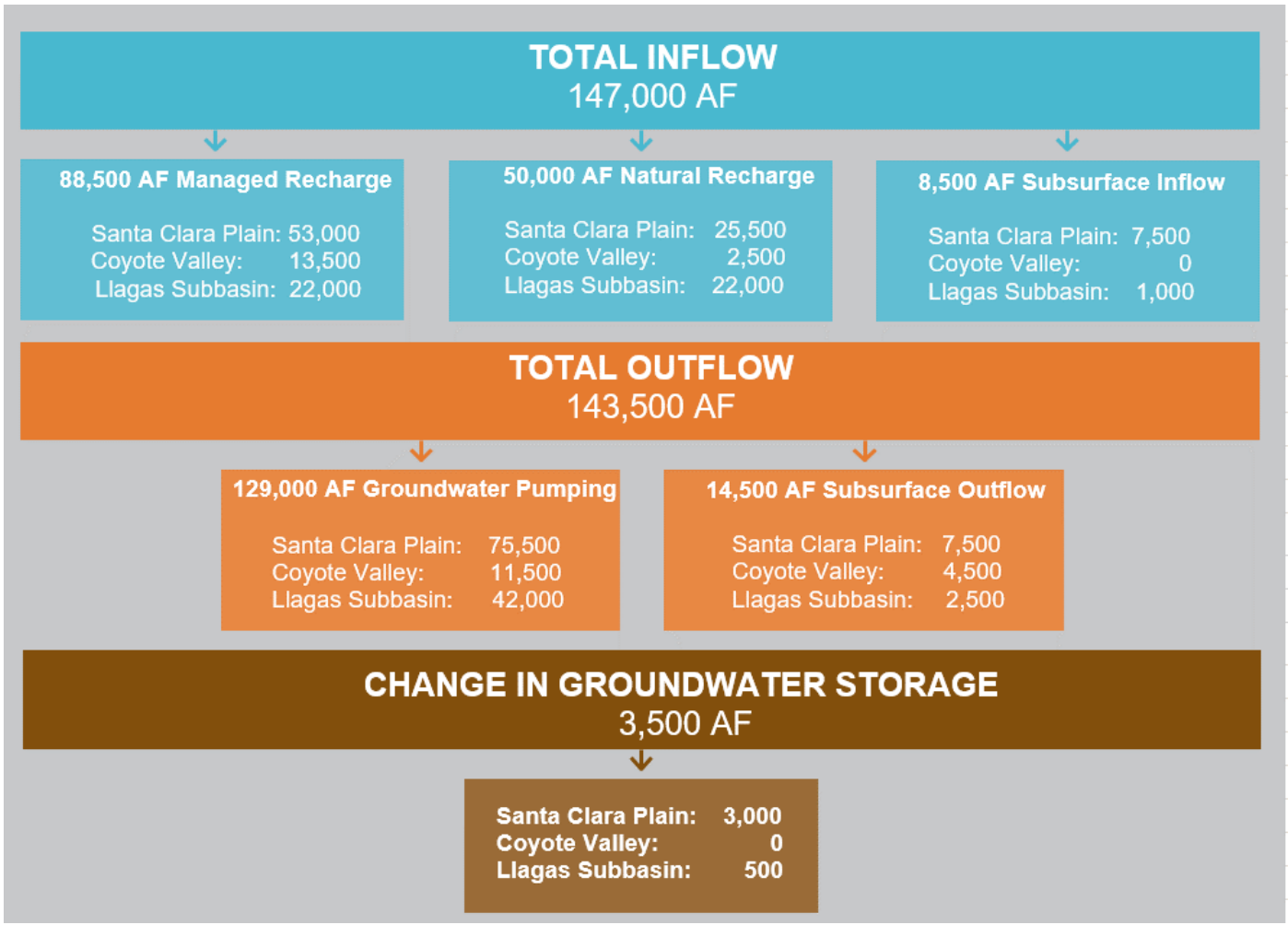
A Includes net district and non-district surface water supplies and estimated rainfall recharge to groundwater basins.
B Natural recharge - Groundwater recharge not controlled by Valley Water, including rainfall and other natural seepage, irrigation return flows, and leakage from water systems, storm drains, and sewer/septic systems.
C Net imported supplies – Surface water imported from the Sacramento-San Joaquin Delta that is used to replenish groundwater or to supply water treatment plants and surface water users in Santa Clara County. This excludes water transferred into the Semitropic Water Bank in Kern County and imported water stored (i.e., carried over) for future use.
D Managed local supplies – Watershed rainfall/runoff captured in local reservoirs or previously stored local water that is used to replenish groundwater or to supply water treatment plants and surface water users in Santa Clara County. This excludes estimated evaporation and local supplies stored for future use.
E Includes municipal, industrial, agricultural and domestic uses.

From FY 2020-21 Protection and Augmentation of Water Supplies Report (Valley Water, 2020)
Calendar Year 2019 represents the most recent year not significantly affected by extended drought.

4.4 GROUNDWATER BUDGET

This section presents detailed groundwater budgets for the Santa Clara and Llagas subbasins averaged for calendar years 2010 through 2019. This period was chosen to represent recent longer-term conditions that include wet, normal, and dry years, in addition to the extended drought of 2012–2016. As shown in Figure 4-6, groundwater pumping far exceeds natural replenishment and Valley Water managed recharge is needed to ensure a balanced water budget and avoid chronic overdraft. The average change in storage over this period is 3,000 AF for the Santa Clara Plain, 0 AF for the Coyote Valley, and 500 AF for the Llagas Subbasin, indicating the subbasins are in long-term balance.

Figure 4-6. Groundwater Budget for the Santa Clara and Llagas Subbasins (2010–2019)



4.4.1 Santa Clara Subbasin

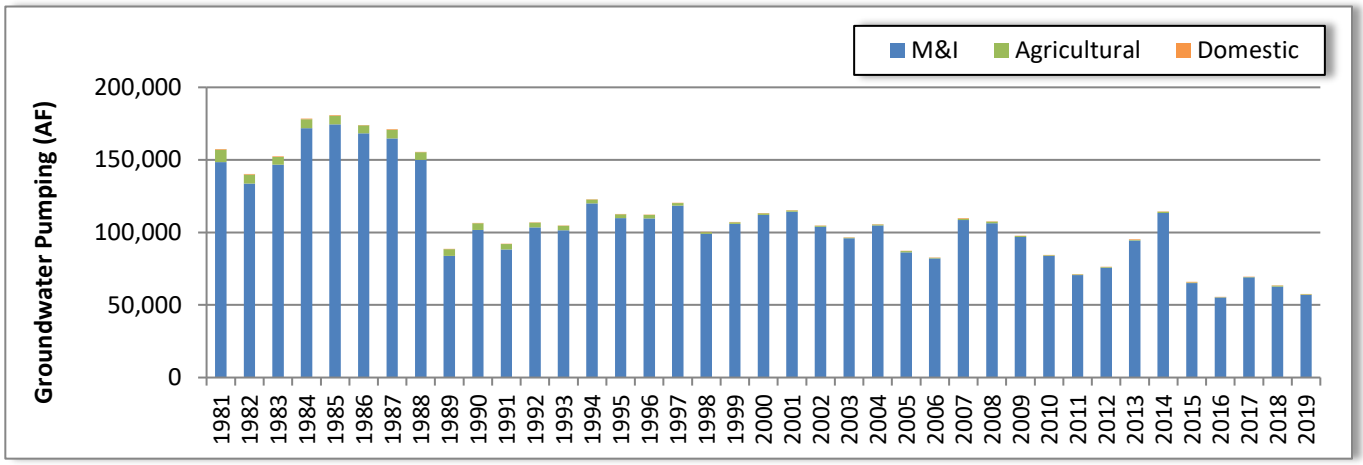
Groundwater is an important water supply source in the Santa Clara Subbasin, particularly in the Coyote Valley, which is entirely reliant on groundwater with the exception of minor surface water use. This section presents detailed information on the water budget for the Santa Clara Subbasin.

4.4.1.1 Groundwater Pumping

The long-term average groundwater pumping in the Santa Clara Subbasin is 87,000 AFY, including the Santa Clara Plain and Coyote Valley. This is based on average pumping from 2010 to 2019, which was chosen to represent recent longer-term conditions that include wet, normal, and dry (drought) years.

Average 2010 to 2019 groundwater pumping in the Santa Clara Plain is 75,000 AFY, with maximum and minimum annual pumping of 115,000 AF in 2014 and 56,000 AF in 2016, respectively. Nearly all groundwater used in the Santa Clara Plain (99%) is for municipal and industrial uses with only 1% for agriculture and domestic purposes (Figure 4-7). Pumping by water retailers accounts for over 90% of pumping in the Santa Clara Plain.

Figure 4-7. Santa Clara Plain Groundwater Pumping by Use



Groundwater serves nearly all beneficial uses in the Coyote Valley, with only small amounts of raw surface water used. Average 2010 to 2019 pumping is 12,000 AFY, with maximum and minimum annual amounts of 12,700 AF in 2010 and 9,500 AF in 2015, respectively. Most groundwater used (72%) supports municipal and industrial uses, with 26% used for agriculture, and 2% for domestic purposes (Figure 4-8). Pumping by water retailers accounts for about 63**%** of pumping in the Coyote Valley. Figure 4-9 shows the distribution of pumping in the Santa Clara Subbasin based on 2019.

Figure 4-8. Coyote Valley Groundwater Pumping by Use

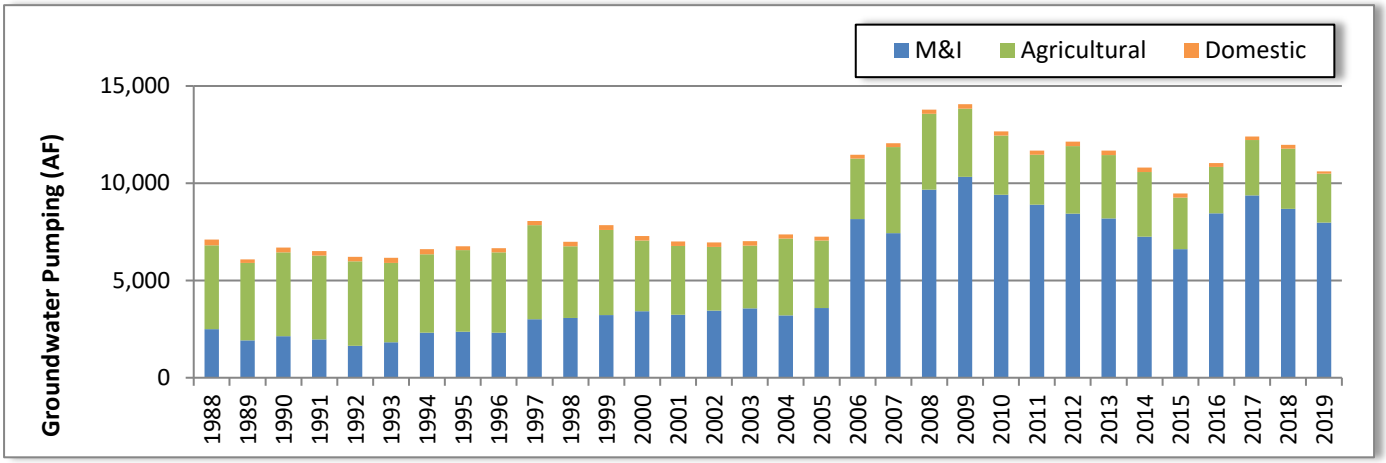
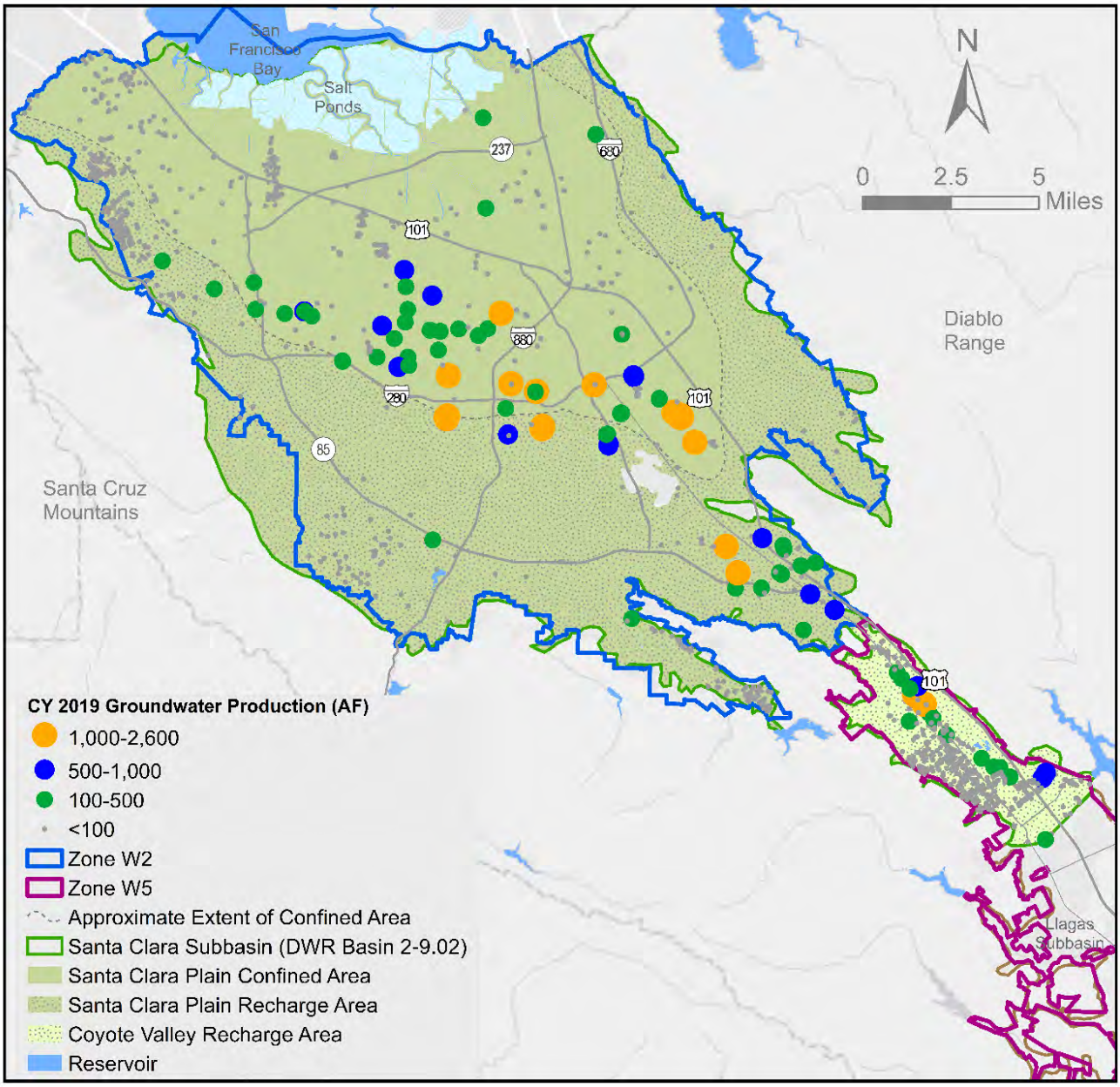


Figure 4-9. Santa Clara Subbasin Pumping Distribution (2019)



SGMA defines the sustainable yield as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.[67] Quantifying sustainable yield is challenging as it is highly dependent on hydrology, available water supplies, managed recharge, site-specific pumping, and basin conditions. While sustainable yield is defined as the maximum amount that may be withdrawn annually, estimating

[67] California Department of Water Resources website: http://water.ca.gov/groundwater/sgm/definitions.cfm

this highly complex concept with a single value may imply that volume can be pumped every year while maintaining sustainable conditions. This is not the case in the Santa Clara Subbasin.

Previous analysis has estimated that annual Santa Clara Plain pumping should not exceed 200,000 AF in any one year,[68] and current production is well below this limit. While that volume could potentially be pumped within a year without causing land subsidence, Valley Water does not rely on this estimate for annual operations or long-term water supply planning. There is no similar estimate for the Coyote Valley, which is small, relatively shallow and transmissive, with limited storage capacity.

Valley Water does not manage to a particular value for sustainable yield, but instead manages groundwater to maintain sustainable conditions through annual operations and long-term water supply planning. Annual operations planning considers available water supplies and projected demands in determining the source and volume of water to be delivered for managed recharge, drinking water treatment, or other use. Each year, Valley Water evaluates the projected end of year groundwater storage and water supply risks to determine if short-term water use reduction is needed in accordance with the Water Shortage Contingency Plan. Valley Water's long-term water supply planning efforts account for maintaining adequate groundwater supplies and reserves in related water system modeling and analysis.

The Santa Clara Subbasin is not in a condition of chronic overdraft due to Valley Water's managed recharge of local imported water as well as in-lieu recharge activities. The hydrographs presented in Chapter 2 and balanced water budgets in this chapter demonstrate that long-term average yields are sustainable. Valley Water makes investments, implements programs, and modifies water supply operations as needed to maintain sustainable conditions now and in the future.

4.4.1.2 Groundwater Recharge

Recharge sources in the Santa Clara Subbasin include Valley Water managed recharge and natural, or uncontrolled, recharge from the deep percolation of rainfall, septic system and irrigation return flows, and natural seepage through creeks. Valley Water's managed recharge systems in the Santa Clara Subbasin are summarized below in Table 4-2, with more detail provided in Appendix I.

Table 4-2. Santa Clara Subbasin Managed Recharge Facility Summary

Managed Recharge System	Approximate Recharge Capacity (AFY)	Water Supply Sources	Year Operations Began
Guadalupe	25,000	Local watersheds, SWP, CVP	1932
Los Gatos	30,000	Local watersheds, SWP, CVP	1934
Penitencia	7,000	Local watersheds, SWP	1934
West Side	15,000	Local watersheds, SWP, CVP	1935
Coyote	27,000[1]	Local watersheds, CVP	1934

1. The Coyote Recharge System can also provide water to the Llagas Subbasin.

[68] Santa Clara Valley Water District, Operational Storage of Santa Clara Valley Groundwater Basin, 1999.

Natural, or uncontrolled, recharge from precipitation, return flows, seepage from creeks, and mountain front recharge is estimated to range between 18,000 and 57,000 AFY for the Santa Clara Plain and between 800 and 4,200 AFY for Coyote.

4.4.1.3 Groundwater Storage

Large amounts of water can be stored in the Santa Clara Subbasin, with total storage capacity estimated to be as high as 1.9 million AF.[69] However, only a fraction of this water can be extracted practically using wells and without causing undesirable results such as land subsidence and seawater intrusion.

The estimated operational storage capacity of the Santa Clara and Llagas subbasins is up to 548,000 AF. Valley Water has estimated the operational storage capacity of the Santa Clara Plain to be 350,000 AF using iterative simulations of water supply system models and the groundwater flow model.[70] Using hydrology, demands, and operational data for the period of 1967-1996, this represents the maximum cumulative storage in the Santa Clara Plain without initiating land subsidence or causing high groundwater nuisance conditions. During the next five-year update, Valley Water will evaluate this estimate using updated data and the calibrated groundwater flow model to determine if it needs to be refined.

Valley Water has previously estimated the operational storage capacity of the Coyote Valley to range between 23,000 and 33,000 AF.[71] This represents the product of specific yield[72], area, and the elevation difference between high and low groundwater surfaces. Groundwater level data for 1982-1983 was used for the high surface and 1976-1977 for low conditions. While Valley Water developed a groundwater flow model for the Coyote Valley since operational storage capacity was last estimated, pumping and recharge data is not available before 1987 when Valley Water assumed groundwater management of the Coyote Valley. During the next five-year update, Valley Water will evaluate the estimate of operational storage capacity to determine if it needs to be refined.

Figures 4-10 and 4-11 show the estimated annual change in groundwater storage in the Santa Clara Plain and Coyote Valley, respectively. The Santa Clara Plain figure starts with the year 1970 and Coyote Valley with 1987 because the data in Coyote Valley only became available after Valley Water merged with the Gavilan Water District. In the Santa Clara Plain, the average annual change in storage over the periods of 1970 to 2019 and 2010 to 2019 was about 6,300 AF and 2,900 AF, respectively. In the Coyote Valley, the average annual change in storage over the periods of 1987 to 2019 and 2010 to 2019 was about -50 AF and 180 AF, respectively.

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[69] California State Water Resources Board, Santa Clara Valley Investigation, 1955.
[70] Santa Clara Valley Water District, Operational Storage of Santa Clara Valley Groundwater Basin, 1999.
[71] Santa Clara Valley Water District, Operational Storage Capacity of the Coyote and Llagas Groundwater Subbasins, April 2002.
[72] Specific yield essentially represents the amount of water that can be released from a certain volume of aquifer.

Figure 4-10. Annual Change in Storage in the Santa Clara Plain (1970–2019)

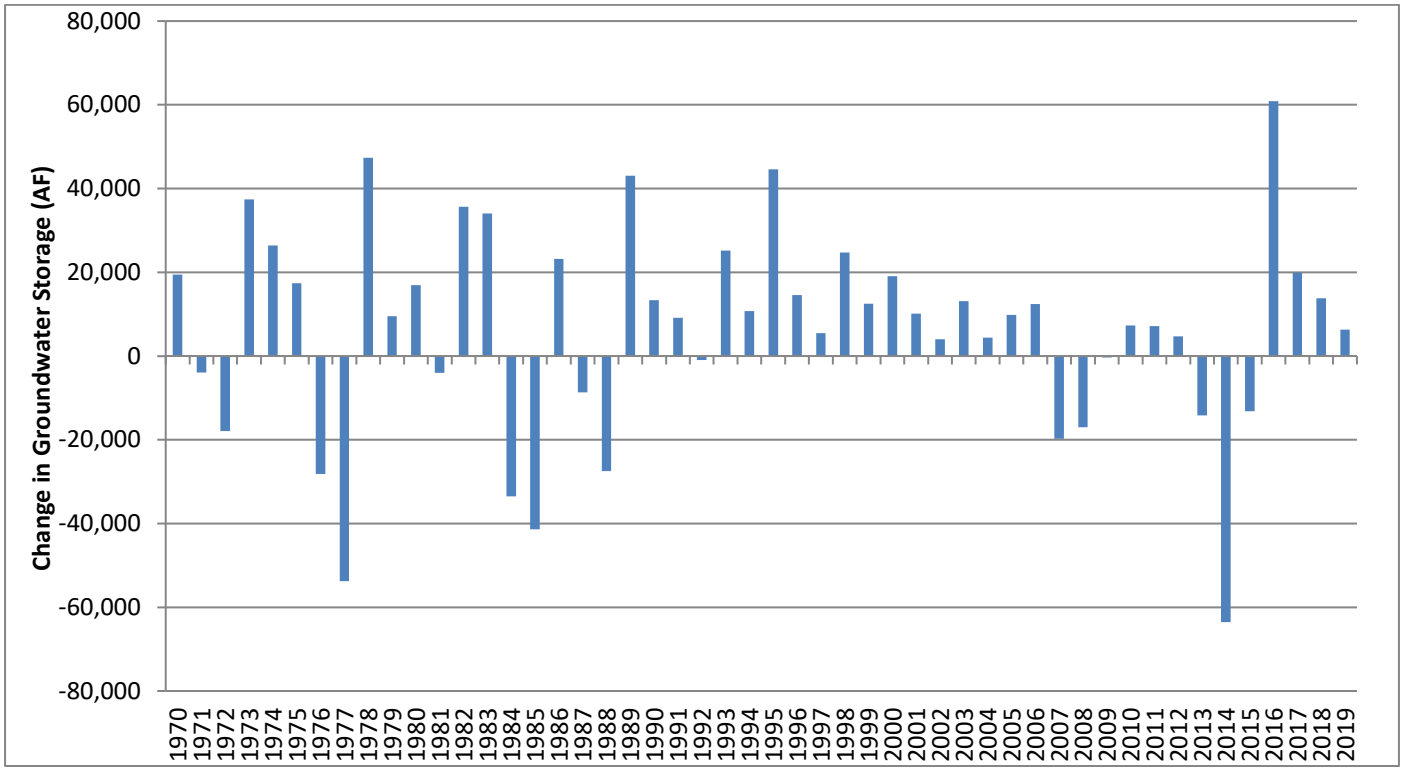
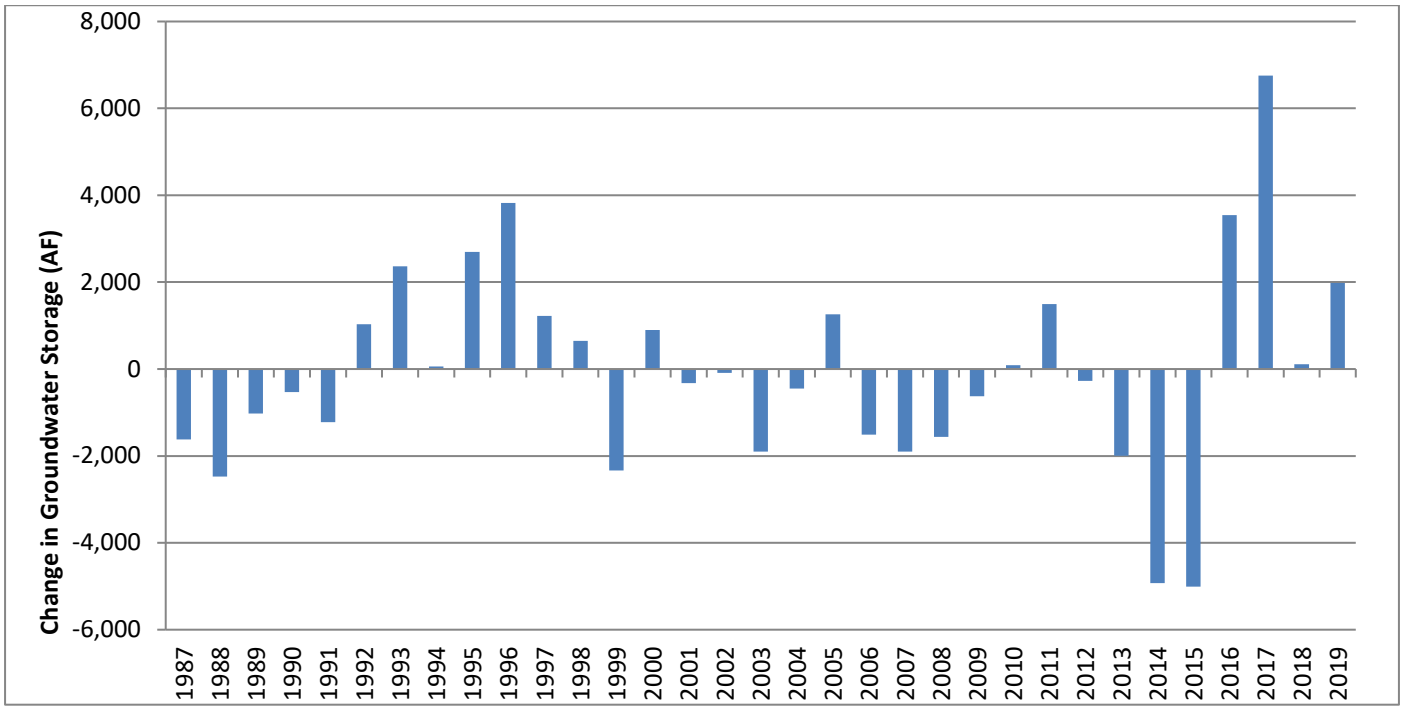


Figure 4-11. Annual Change in Storage in the Coyote Valley (1987–2019)



4.4.1.4 Water Budget

A water budget for the Santa Clara Plain for calendar years 2010 through 2019 is shown in Table 4-3. The water budget is based on Valley Water groundwater flow model for the Santa Clara Plain and represents inflows and outflows for the principal aquifer. On average, about 62% of inflows to groundwater in the Santa Clara Plain come from Valley Water's managed recharge program (Table 4-3). Although the water budget can vary significantly from year to year, on average, there was an average annual increase in storage by about 3,000 AFY for the Santa Clara Plain over this 10-year period.

Table 4-3. Santa Clara Plain Principal Aquifer Budget (2010–2019)

Water Budget Component	Acre-Feet per Year
Inflow	
Managed Recharge[1]	53,000
Natural Recharge[2]	25,500
Subsurface Inflow[3]	7,500
Total Inflow	86,000
Outflow	
Groundwater Pumping[4]	75,500
Subsurface Outflow[5]	7,500
Total Outflow	83,000
Change in Storage	3,000

Notes:
1. Managed recharge represents direct replenishment by Valley Water using local and imported water.
2. Natural recharge includes the deep percolation of rainfall, natural seepage from creeks, and subsurface inflow from surrounding hills (mountain front recharge).
3. Subsurface inflow represents inflow from adjacent aquifer systems, including the Coyote Valley
4. Pumping is based on metered pumping volumes (about 94% of pumping), or pumping reported by well owners based on a table of average use.
5. Subsurface outflow represents outflow to adjacent aquifers in San Mateo County, Alameda County, and beneath San Francisco Bay.

A water budget for the Coyote Valley for calendar years 2010 to 2019 is presented in Table 4-4. The water budget is based on Valley Water's groundwater flow model for the Coyote Valley and represents inflows and outflows for the aquifer system. Recharge from rainfall is estimated to be small compared to Valley Water's managed recharge in Upper Coyote Creek and natural recharge along Fisher Creek. Annual inflow is estimated to be about 16,000 AFY, with approximately 84 percent of that coming from Valley Water's managed recharge (Table 4-4). The primary Coyote Valley outflows are groundwater pumping and flow to the Santa Clara Plain, the latter helps to maintain water levels in the Santa Teresa area of the Santa Clara Plain. The average annual change in storage between 2010 and 2019 is approximately zero, indicating inflows and outflows are generally balanced over the ten-year period.

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Table 4-4. Coyote Valley Budget (2010–2019)

Water Budget Component	Acre-Feet per Year
Inflow	
Managed Recharge[1]	13,500
Natural Recharge[2]	2,500
Subsurface Inflow[3]	0
Total Inflow	16,000
Outflow	
Groundwater Pumping[4]	11,500
Subsurface Outflow[5]	4,500
Total Outflow	16,000
Change in Storage	0

Notes:
1. Managed recharge represents direct replenishment by Valley Water using local and imported water.
2. Natural recharge includes all uncontrolled recharge, including the deep percolation of rainfall, septic system and/or irrigation return flows, and natural seepage through creeks.
3. Subsurface inflow represents inflow from adjacent aquifer systems.
4. Pumping is based on metered pumping volumes (about 91% of pumping), or pumping reported by well owners based on a table of average uses.
5. Subsurface outflow represents outflow to adjacent aquifer systems, including outflow to the Santa Clara Plain.

4.4.2 Llagas Subbasin

Groundwater is the primary water supply source for nearly all beneficial use in the Llagas Subbasin and is the sole source for drinking water. A small, but growing portion of water use is served by recycled water, and there is also a small amount of raw surface water put to beneficial use. This section presents detailed information on the water budget.

4.4.2.1 Groundwater Pumping

The long-term average groundwater pumping in the Llagas Subbasin is about 42,000 AFY (Figure 4-12). This is based on average pumping from 2010 to 2019, which was chosen to represent recent longer-term conditions that include wet, normal, and dry (drought) years. The maximum annual pumping during that period was about 47,500 AF in 2013 and the minimum pumping was 39,500 AF in 2010 (Figure 4-12). Groundwater use in the Llagas Subbasin is nearly evenly split between agricultural uses (52%) and municipal and industrial uses (43%), with 5% used for domestic purposes (Figure 4-12). Pumping by water retailers accounts for about 36% of pumping in the Llagas Subbasin. Figure 4-13 shows the distribution of pumping in the Llagas Subbasin in 2019.

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Figure 4-12. Llagas Subbasin Groundwater Pumping by Use

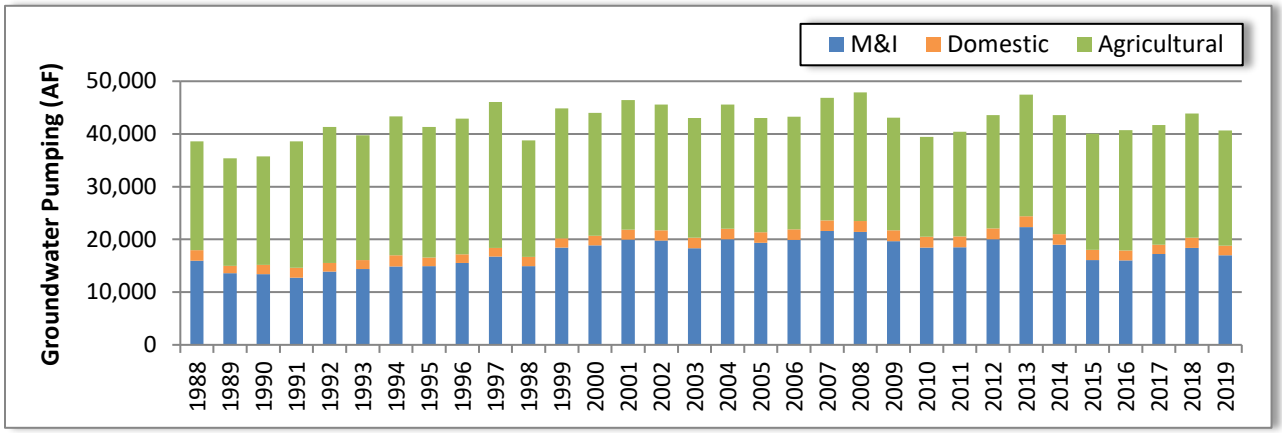
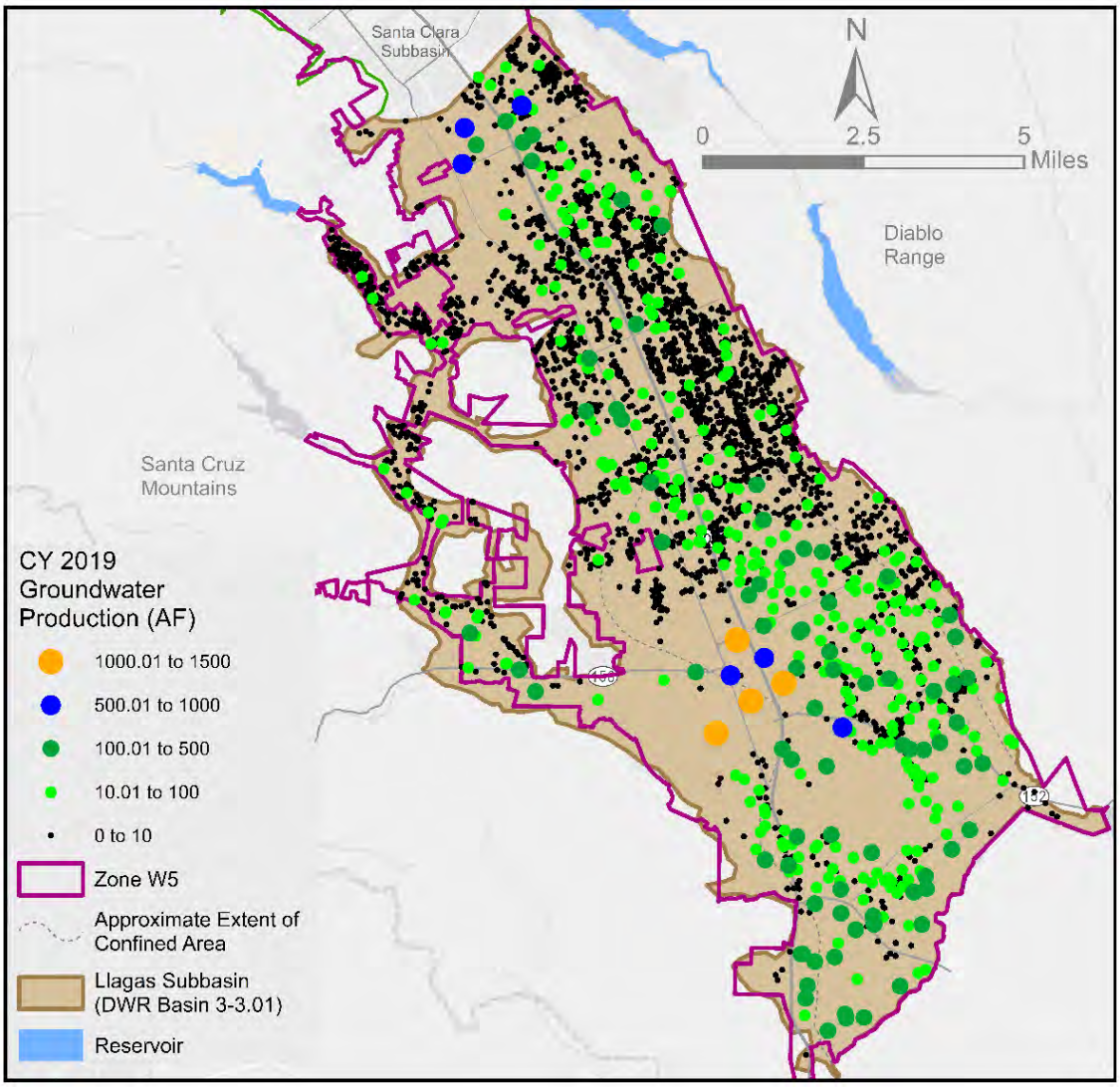


Figure 4-13. Llagas Subbasin Pumping Distribution (2019)



Quantifying sustainable yield is challenging as it is highly dependent on hydrology, available water supplies, managed recharge, site-specific pumping, and basin conditions. While sustainable yield is defined as the maximum amount that may be withdrawn annually, estimating this highly complex concept with a single value may imply that volume can be pumped every year while maintaining sustainable conditions. Certainly, this is not the case with the Llagas Subbasin.

As explain previously for the Santa Clara Subbasin, Valley Water does not manage to a particular value for sustainable yield, but instead manages groundwater to maintain sustainable conditions through annual operations and long-term water supply planning. Each year, Valley Water evaluates the projected end of year groundwater storage to determine if short-term water use reduction is needed in accordance with the Water Shortage Contingency Plan. Valley Water's long-term water supply planning efforts account for maintaining adequate groundwater supplies and reserves in related water system modeling and analysis.

The Llagas Subbasin is not in a condition of chronic overdraft because of Valley Water's managed recharge of local and imported surface water. The hydrographs presented in Chapter 3 and balanced water budget in this chapter demonstrate that long-term average yields are sustainable. Valley Water makes investments, implements programs, and modifies water supply operations as needed to maintain sustainable conditions now and in the future.

4.4.2.2 Groundwater Recharge

Recharge sources in the Llagas Subbasin include Valley Water managed recharge and natural, or uncontrolled, recharge from the deep percolation of rainfall, septic system and/or irrigation return flows, and natural seepage through creeks. Valley Water's managed recharge systems in the Llagas Subbasin are summarized below in Table 4-5, with more detail provided in Appendix I.

Table 4-4. Llagas Subbasin Managed Recharge Facility Summary

Managed Recharge System	Approximate Recharge Capacity (AFY)	Water Supply Sources	Year Operations Began
Coyote	27,000[1]	Local watersheds, CVP	1934
Lower Llagas	21,000	Local watersheds	1955
Upper Llagas	19,000	Local watersheds, CVP	1955

1. The Coyote Recharge System also provides water to the Santa Clara Subbasin.

Natural, or uncontrolled, recharge from precipitation, return flows, seepage from creeks, and mountain front recharge is estimated to range between 15,000 and 27,000 AFY for the Llagas Subbasin based on 2010 to 2019.

4.4.2.3 Groundwater Storage

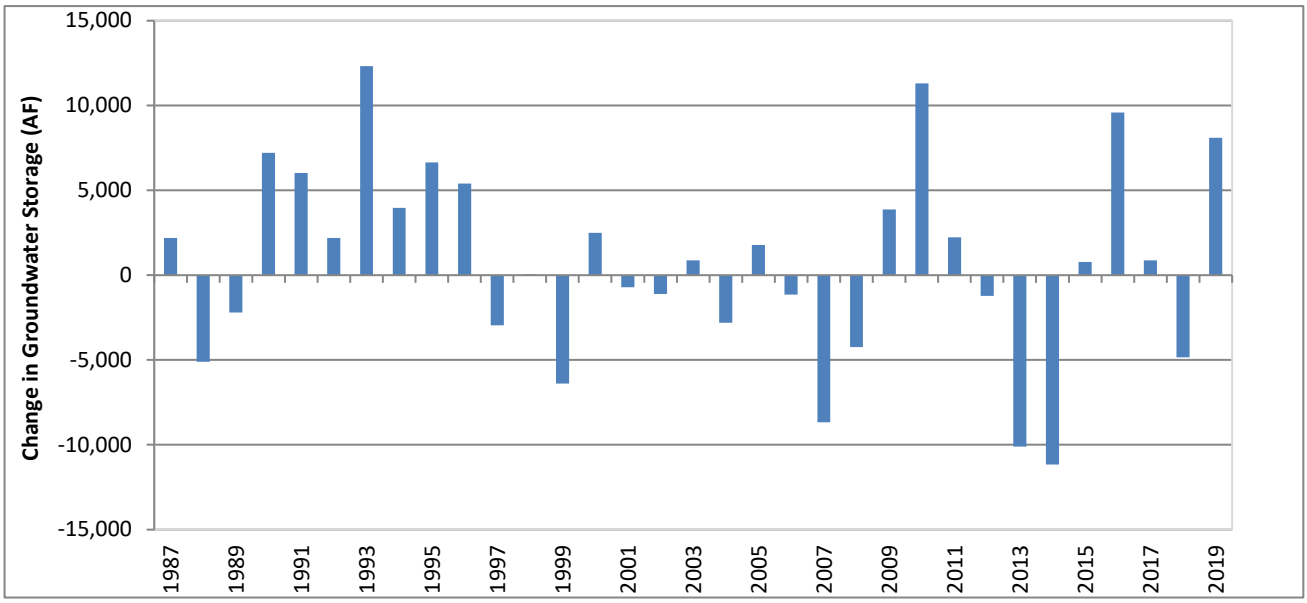
Valley Water has previously estimated the operational storage capacity of the Llagas Subbasin to range between 152,000 and 165,000 AF.[73] The operational storage capacity is less than total storage capacity as it accounts for the avoidance of adverse impacts. The operational storage capacity estimate is based on the product of specific yield[74], area, and the elevation difference between high and low groundwater surfaces. Groundwater level data

[73] Santa Clara Valley Water District, Operational Storage Capacity of the Coyote and Llagas Groundwater Subbasins, April 2002.
[74] Specific yield essentially represents the amount of water that can be released from a certain volume of aquifer.

for 1982–1983 was used for the high groundwater surface and 1976–1977 for low conditions. While Valley Water has developed a groundwater flow model for the Llagas Subbasin since its operational storage capacity was last estimated, pumping and recharge data is not available before 1987 when Valley Water assumed groundwater management of the Llagas Subbasin, and Valley Water has not updated its storage estimate. During the next five-year update, Valley Water will re-evaluate the estimate of operational storage capacity to determine if it needs to be refined.

Figure 4-14 shows the estimated annual change in groundwater storage in Llagas Subbasin from 1987 (the year Valley Water assumed management of the subbasin) to 2019. In the Llagas Subbasin, the average annual change in storage over the periods of 1987 to 2019 and 2010 to 2019 was about 730 AF and 450 AF, respectively.

Figure 4-14. Annual Change in Storage in the Llagas Subbasin (1987–2019)



4.4.2.4 Water Budget

A water budget for the Llagas Subbasin principal aquifer for calendar years 2010 to 2019 is presented in Table 4-6. This budget is based on Valley Water's groundwater flow model for the Llagas Subbasin and represents general subbasin inflows and outflows. Annual inflow is estimated to be 45,000 AFY, with about half coming from Valley Water's managed recharge of local and imported water, and the other half from natural recharge.

The major outflow is groundwater pumping, which averages 42,000 AFY (Table 4-6). The subsurface outflow, which includes flows to the North San Benito Subbasin in San Benito County, is estimated to be about 2,500 AFY. The average annual change in storage between 2010 and 2019 is approximately 500 AF, indicating inflows and outflows are generally balanced over the ten-year period (Table 4-6).

Table 4-5. Llagas Subbasin Principal Aquifer Budget (2010–2019)

Water Budget Component	Acre-Feet per Year
Inflow	
Managed Recharge[1]	22,000
Natural Recharge[2]	22,000
Subsurface Inflow[3]	1,000
Total Inflow	45,000
Outflow	
Groundwater Pumping[4]	42,000
Subsurface Outflow[5]	2,500
Total Outflow	44,500
Change in Storage	500

Notes:
1. Managed recharge represents direct replenishment by Valley Water using local and imported water.
2. Natural recharge includes all uncontrolled recharge, including the deep percolation of rainfall, septic system and/or irrigation return flows, and natural seepage through creeks.
3. Subsurface inflow represents inflow from adjacent aquifer systems, including inflow from the North San Benito Subbasin in San Benito County.
4. Pumping is based on metered pumping volumes (about 81% of pumping), or pumping reported by well owners using a table of average uses.
5. Subsurface outflow represents outflow to adjacent aquifer systems, including outflow to the North San Benito Subbasin in San Benito County.

4.5 FUTURE DEMANDS

Valley Water's 2020 UWMP[75] includes a comprehensive assessment of projected future water supplies and demands in Santa Clara County over the next 25 years. Estimating future demands allows Valley Water to manage the county's water supply, including the Santa Clara and Llagas subbasins and appropriately plan infrastructure investments.

The projected demands in the Santa Clara and Llagas subbasins for this GWMP are based on data used to develop Valley Water's 2020 UWMP. Due to expected population increases and job growth, countywide demands are projected to increase from 306,000 AFY in 2020 to approximately 345,000 AFY in 2045 (2020 UWMP). Although projected 2045 demand is higher than present demand, this number is still down from a peak in the 1990s and 2000s because of significant conservation efforts from Valley Water and the State.

Valley Water forecasts projected average water supplies using its Water Evaluation and Planning (WEAP) model to simulate future demands, investments, and certain expected future regulations using the historical hydrology from 1922-2015 (94 years) (2020 UWMP). Valley Water maintains diverse water supply sources to meet countywide demands, including local surface water and groundwater, imported water, and recycled water (2020 UWMP). Water conservation is also an important part of the water supply mix and helps improve water supply reliability. Valley Water is considering investing in projects to help mitigate potential decrease of future supply due to climate change and new regulations. Valley Water's Water Supply Master Plan 2040 (WSMP)[76] provides a strategy for

[75] The 2020 Urban Water Management Plan is available on Valley Water's website at: https://www.valleywater.org/your-water/water-supply-planning/urban-water-management-plan
[76] The Water Supply Master Plan 2040 is available on Valley Water's website at: https://www.valleywater.org/your-water/water-supply-planning/water-supply-master-plan

meeting future water demands, and Valley Water continuously uses an annual Monitoring and Assessment Program (MAP) to track WSMP strategy implementation. With the phased implementation of planned future projects, Valley Water's available supplies are projected to increase over time. Valley Water's many supply sources are subject to hydrologic variability and additional constraints including regulatory constraints, climate change, and water quality variations.

As part of the 2020 UWMP, Valley Water developed a Water Shortage Contingency Plan (WSCP) to establish actions and procedures for managing water supplies and demands during water shortages due to droughts and other emergencies. Valley Water uses projected countywide end of year groundwater storage in the Santa Clara and Llagas subbasin as an indicator of potential water shortages and a trigger for WSCP actions. In the event of prolonged droughts or other emergency situations, Valley Water considers all available tools for managing available water supplies, including public education and community outreach, coordinating response among the County's municipalities and retailers, augmenting supplies by investing in supplemental supply sources, calling for short-term water use reductions, and balancing demands for treatment plants and recharge facilities, to maximize the use of available supplies in order to meet potential shortages. The WSCP also summarizes planning for natural disaster, drought-related revenue impacts, and Valley Water's legal authority to respond to water shortages. As described in Chapter 5 of this GWMP, the outcome measures and associated outcome measure-lower threshold for groundwater storage are based on stages of the WSCP.

Valley Water's long-term water supply level of service goal is to meet 100% of annual water demand during non-drought years and at least 80% of annual water demand in drought years (2020 UWMP). A reliable water demand forecast is critical in determining the level of investment necessary to meet the level of service goal. The countywide total water use is provided in Table 4-7. Future water use is projected to increase over time with population growth but will be well within the range of historic data (2020 UWMP).

Table 4-6. Projected Countywide Demands (AF)

Use Type	2025	2030	2035	2040	2045
Retailer Demand	288,000	280,000	285,000	290,000	299,000
Agricultural Irrigation	25,000	25,000	25,000	25,000	25,000
Independent Groundwater Pumping	14,000	14,000	14,000	14,000	14,000
Untreated Surface Water	2,000	2,000	2,000	2,000	2,000
Losses	3,000	3,000	3,000	3,000	3,000
Total	**330,000**	**325,000**	**330,000**	**335,000**	**345,000**

Groundwater demand projections in the Santa Clara and Llagas subbasins are included in the use types of retailer demand, agricultural irrigation, and independent groundwater pumping (Table 4-7). Retailer demand from the 13 water supply retailers represents the majority of countywide demand and is projected to increase by about 4% between 2025 and 2045 based on historic data. Independent groundwater pumping in the Santa Clara and Llagas subbasins includes groundwater pumping by individual domestic well owners, small and mutual water companies, businesses, non-agricultural irrigation, and environmental cleanup. This use type includes all non-retailer groundwater pumping in the Municipal and Industrial (M&I) and domestic categories. Independent groundwater is projected to remain constant between 2025 and 2045. Agricultural groundwater pumping in the Santa Clara and

Llagas subbasins has been generally constant over the last twenty years at approximately 25,000 AFY and is projected to remain constant throughout 2045 (Table 4-7).

Based on Valley Water's existing and planned sources of supply, Valley Water will be able to meet countywide demands through 2045 under normal, a single dry, and five consecutive dry year conditions (2020 UWMP). If a five-year drought were to occur in the next five years, Valley Water would employ a range of response actions, including water conservation, bringing back water stored in the Semitropic Groundwater Storage Bank in Kern County, imported water transfers and exchanges, and calling for short-term water use reduction. These and other response actions have been employed by Valley Water in response to the 2021 extreme drought conditions.

4.6 CLIMATE CHANGE IMPACTS ON GROUNDWATER BUDGET

Climate change in California is likely to increase air temperatures, shrink snowpack, increase weather extremes, result in sea-level rise, and increase the frequency of prolonged droughts. Climate change has become an important factor in water resources planning in the State and region, although the extent and precise effects of climate change remain uncertain. Therefore, sustainable groundwater management for the Santa Clara and Llagas subbasins requires consideration of climate change. The 2021 GWMP includes a projected groundwater budget incorporating climate change and expected population growth, which is one of five recommended actions by DWR in their review and approval of the 2016 GWMP as an Alternative Plan (Appendix C). The climate change information in the 2021 GWMP is generally consistent with the 2020 UWMP.

Climate change is expected to affect future water supplies and demands, which will likely impact the groundwater budget. While the effects of climate change on demand are not certain, it is anticipated that warmer temperatures and altered rainfall patterns associated with climate change could lead to greater water demands. According to a climate study conducted by Valley Water, average annual maximum temperature within Santa Clara County could increase by 2.0˚F by 2050 under the business-as-usual scenario, while precipitation in the county will continue to exhibit high year-to-year variability with very wet and very dry years. Projected future increases in temperature can lead to: 1) increased irrigation demands for outdoor landscape or agricultural; 2) increased water use in cooling towers; and 3) increased drought severity and/or length, which could increase the need to request drought-related water use reductions (2020 UWMP).

A modified approach based on DWR's 2018 climate change guidance document[77] was used to develop groundwater budgets for the Santa Clara and Llagas subbasins that incorporate climate change and population growth for 2045. The future climate scenario for 2045 was used to be consistent with Valley Water's other long-term water supply and operations planning, including the 2020 UWMP (Table 4-7). The modeling used spatially downscaled output of precipitation and air temperature from an ensemble of 10 general circulation models (GCMs) (also called global climate models). Using an ensemble of different GCMs for planning studies is the current best scientific practice to consider the range and uncertainty of future climate projections. An ensemble of 10 GCMs is large enough where characterization of ensemble mean and variability tends to be relatively insensitive to the individual selection of GCMs[78]. The 10 GCMs simulations conducted as part of the Coupled Model Intercomparison

[77] California Department of Water Resources (DRW), 2018, Guidance document for the sustainable management of groundwater – Guidance for climate change during groundwater sustainability plan development, July 2018. Available at: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents

[78] Maurer, E. P., L. Brekke, T. Pruitt, B. Thrasher, J. Long, P. Duffy, M. Dettinger, D. Cayan, and J. Arnold (2014), An enhanced archive facilitating climate impacts and adaptation analysis, Bulletin of the American Meteorological Society, doi:10.1175/bams-d-13-00126.1.

Project – Phase 5 (CMIP5)[79] were used as recommended by DWR because they are the most appropriate projections for water resources planning and analysis in California (Table 4-8) (DWR, 2018). To be consistent with Valley Water's current long-term water planning with the Water Supply Master Plan 2040 (WSMP) and associated Monitoring and Assessment Program (MAP), the same subset of four GCMs (Table 4-8) were used to calculate the projected groundwater budget in 2045.

Table 4-8. Global Climate Models (GCMs)

General Circulation Models (GCM)	Source Institution
ACCESS-1.0	Commonwealth Scientific and Industrial Research Organization (CSIRO) and Bureau of Meteorology, Australia
CanESM2*	Canadian Centre for Climate Modeling and Analysis
CCSM4	National Center for Atmospheric Research (NCAR)
CESM1-BGC	The National Science Foundation, The U.S. Department of Energy, and National Center for Atmospheric Research
CMCC-CMS	Centro Euro-Mediterraneo per Cambiamenti I Climatici, Italy
CNRM-CM5*	Centre National de Recherches Meteorologiques (CNRM), and Centre Europeen de Recherches et de Formation Avancee en Calcul Scientifique, France
GFDL-CM3*	Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration (NOAA)
HadGEM2-CC	Met Office Hadley Centre
HadGEM2-ES	Met Office Hadley Centre (additional HadGEM2-ES realizations contributed by Instituto Nacional de Pesquisas Espaciais)
MIROC5*	Atmosphere and Ocean Research Institute, University of Tokyo, National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology

*subset of four GCMs used to project groundwater budgets for calendar year 2045

The selected GCMs used the Intergovernmental Panel on Climate Change (IPCC) representative concentration pathway (RCP) 8.5 for the projected climate scenario in 2045. RCP 8.5 is recommended by DWR (2018) and is generally taken as the basis for the worst-case climate change scenario. The localized constructed analogs (LOCA) method[80] was used for downscaling the GCM precipitation and temperature, as recommended by DWR (DWR, 2018). The LOCA downscaling method maintains specific hydrologically important characteristics at the local scale, and it preserves the large-scale GCM precipitation trends (Pierce et al., 2014). The downscaled GCM data was used as input to Valley Water's groundwater flow and Water Evaluation and Planning (WEAP) models to project the future 2045 groundwater budget. The groundwater models are described in section 7.6 of this 2021 GWMP. The WEAP model simulates future demands, investments, and certain expected future regulations (e.g., local minimum stream flows), and it uses local water demand and conservation savings modeling as input. Additional details about

[79] Taylor, K. E., Stouffer, R. J., and Meehl, G. A. (2012), An Overview of CMIP5 and the experiment design, Bulletin of the American Meteorological Society, 93, 485-498, doi: 410.1175/BAMS-D-1111-00094.00091.

[80] Pierce, D.W., Cayan, D.R., Thrasher, B.L., 2014. Statistical Downscaling Using Localized Constructed Analogs (LOCA). Journal of Hydrometeorology, 15, 2558–2585. https://doi.org/10.1175/JHM-D-14-0082.1

the WEAP model are available in the 2020 UWMP. The use of the groundwater and WEAP models limit the simulations to local scale processes that affect water supply within Santa Clara County. Valley Water has initiated a study to evaluate climate change impacts on imported water supply that will consider projected changes in snowpack, streamflow, and sea-level rise beyond Santa Clara County, as well as potential future regulatory changes. Results from this new study will be integrated in the next five-year update of the GWMP to evaluate climate change and expected population growth on projected groundwater budgets in the Santa Clara and Llagas subbasin over the planning and implementation horizon of 50 years.

Valley Water considers natural groundwater recharge as a source of supply for long-term water supply planning purposes because it contributes to the available groundwater supply (2020 UWMP). Natural recharge is separate from managed recharge and includes the infiltration of rainfall in the recharge areas, natural seepage through local creeks and streams, subsurface flow from the mountains, and infiltration from septic systems and/or irrigation return flow. Projected 2045 natural recharge is summarized in Table 4-9. Based on the 10 GCMs, the ensemble average for natural recharge is about 19%, 16%, and 8% higher in 2045 compared to the 2010–2019 average (Tables 4-3, 4-4, and 4-6) for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin, respectively. The projected natural recharge using the four GCM ensemble is similar magnitude as the 10 GCM ensemble (Table 4-9). The projected increase in 2045 natural recharge is likely the response to projected increases in average annual precipitation in Santa Clara County by the mid- to late-21st century.

Table 4-9. Projected Natural Recharge for the Santa Clara and Llagas Subbasins (Calendar Year 2045)

Global Climate Model (GCM)	Santa Clara Subbasin		Llagas Subbasin
	Santa Clara Plain	Coyote Valley	
ACCESS-1.0	17,400	2,100	20,300
CanESM2*	55,300	4,900	31,700
CCSM4	40,100	3,400	25,700
CESM1-BGC	36,400	3,300	25,400
CMCC-CMS	20,900	2,400	21,600
CNRM-CM5*	22,800	2,600	22,300
GFDL-CM3*	22,100	2,100	20,400
HadGEM2-CC	24,200	2,900	23,500
HadGEM2-ES	44,800	3,800	27,100
MIROC5*	18,600	1,900	19,600
10 GCM average	**30,300**	**2,900**	**23,800**
4 GCM average*	**29,700**	**2,900**	**23,500**
2010–2019 average**	**25,500**	**2,500**	**22,000**

*subset of four GCMs used to project groundwater budgets for calendar year 2045
**average values of natural recharge from 2010 to 2019, as shown in Figure 4-6

The projected 2045 groundwater budget for the Santa Clara and Llagas subbasins is presented in Table 4-10. This budget is based on the subset of four GCMs (Table 4-9) and represents general subbasin inflows and outflows. The projected change in storage for 2045 is approximately -4,800 AF for the Santa Clara Subbasin and 800 AF for the Llagas Subbasin, indicating inflows and outflows are generally balanced in the future scenario (Table 4-10). The

projected change in storage for the Santa Clara Subbasin would be closer to being balanced if these simulations considered the natural recharge from the 10 GCM ensemble and/or 2010–2019 managed recharge (Tables 4-3 and 4-4). Valley Water's 2045 managed and in-lieu recharge programs will likely have the operational flexibility to compensate for the relatively small projected shortfall in change in storage for the Santa Clara Plain (Table 4-10).

Table 4-10. Projected Groundwater Budget for the Santa Clara and Llagas Subbasins (Calendar Year 2045)

	Santa Clara Subbasin			Llagas Subbasin
	Santa Clara Plain	Coyote Valley	Total	Total
Inflow				
Managed Recharge (AF)	32,400	12,100	44,500	21,300
Natural Recharge (AF)	29,700	2,900	32,600	23,500
Subsurface Inflow (AF)	4,800		4,800	
Total Inflow (AF)	66,800	15,000	81,800	44,700
Outflow				
Groundwater Pumping (AF)	72,600	9,300	81,900	43,900
Subsurface Outflow (AF)		4,800	4,800	
Total Outflow (AF)	72,600	14,000	86,600	43,900
Change in Storage (AF)	**-5,800**	**1,000**	**-4,800**	**800**

Note – groundwater budget calculated as an average from the subset of four GCMs (CanESM2, CNRM-CM5, GFDL-CM3, and MIROC5), which are used in Valley Water's Water Supply Master Plan 2040 (WSMP) and Monitoring and Assessment Program (MAP) updates for climate change impact analysis. MAP is described in Chapter 6. The projected groundwater budget was largely based on the WEAP simulations, which doesn't consider all subsurface flow components.

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CHAPTER 5 – SUSTAINABLE MANAGEMENT CRITERIA

This chapter presents Valley Water's groundwater sustainability goals, basin management strategies, outcome measures, and corresponding outcome measure-lower thresholds.

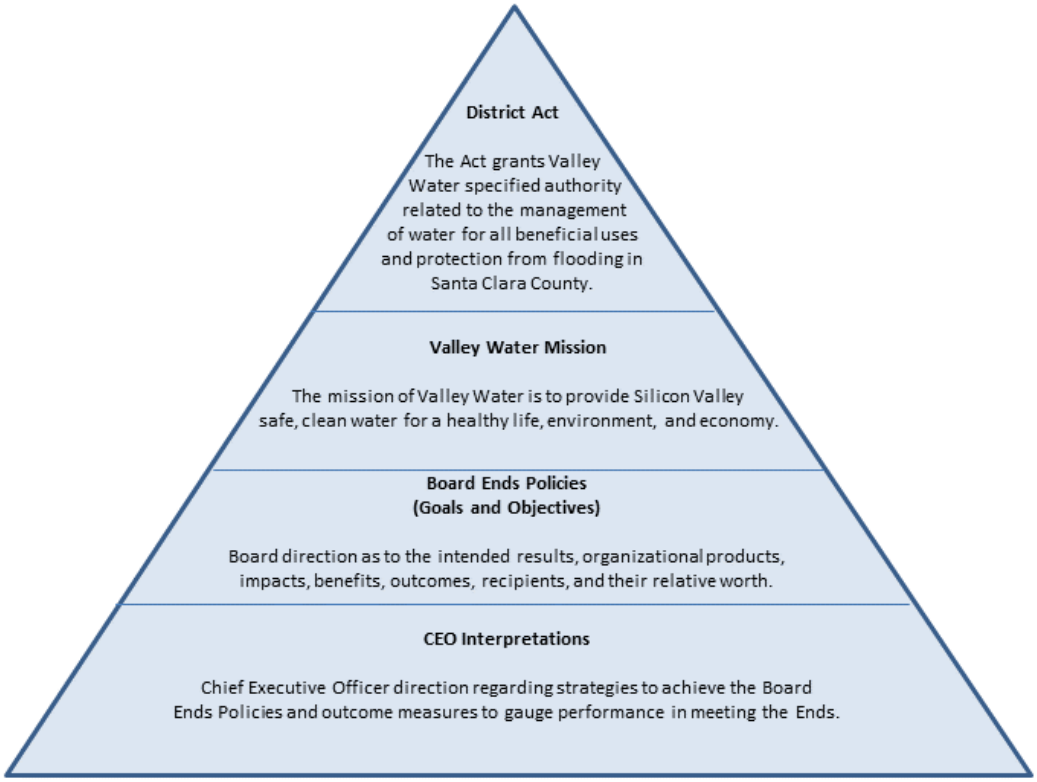
5.1 SUSTAINABLE MANAGEMENT CRITERIA

Valley Water manages the Santa Clara and Llagas subbasins as an integrated component of the overall water supply, and as such, the goals and strategies for groundwater management are based on the Board of Directors Ends Policy E-2 and the water supply goals and objectives listed below.

- Board Water Supply Goal 2.2: Protect and sustain the county's existing, diverse water supplies.
- Board Water Supply Objective 2.2.1: Manage groundwater to ensure sustainable supplies and avoid land subsidence.
- Board Water Supply Objective 2.2.2: Aggressively protect groundwater from the threat of contamination.

Valley Water programs and activities are developed in accordance with the District Act objectives and based on policy guidance from the Board of Directors. The CEO has also developed CEO Interpretations, which include direction, strategies, and outcome measures. Outcome measures are specific, measurable goals to gauge performance toward meeting the Board Ends Policies. The relationship of the District Act, Board policies, and CEO Interpretations is shown below in Figure 5-1 with each level taking direction from the level above.

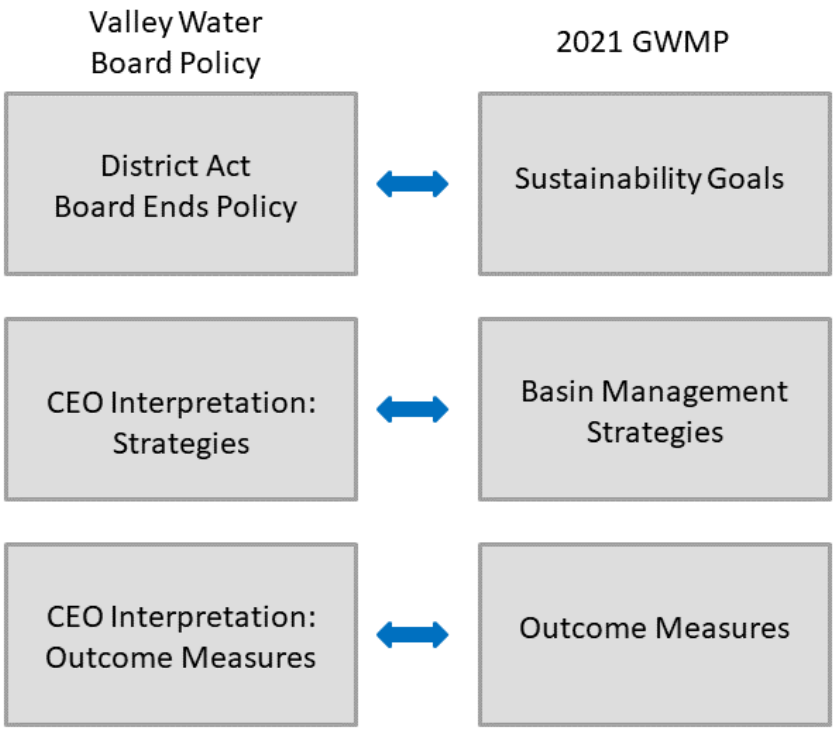
Figure 5-1. Valley Water Policy Framework



Chapter 5 – Sustainable Management Criteria

The sustainability goals and strategies in this GMWP are developed within this policy framework and share a parallel structure. The relationship between the District Act, Valley Water Policies, the sustainability goals, and Valley Water groundwater programs are shown in Figure 5-2. The goals, strategies, and outcome measures are described below.

Figure 5-2. Relation Between Valley Water Policy and 2021 GWMP



5.2 SUSTAINABILITY GOALS

The following sustainability goals related to groundwater supply reliability and protection are identified in Valley Water Board policy:

- Manage groundwater to ensure sustainable supplies and avoid land subsidence.
- Aggressively protect groundwater from the threat of contamination.

These sustainability goals describe the overall objectives of Valley Water's groundwater management programs. The rationale and meaning of these objectives, as well as their relationship to Valley Water policies, are discussed below.

5.2.1 Groundwater Supply Reliability

Goal: Manage groundwater to ensure sustainable supplies and avoid land subsidence.

Local groundwater resources are the foundation of the county's water supply, but they need to be augmented by Valley Water's comprehensive water supply management activities in order to reliably meet the needs of county residents, businesses, agriculture and the environment. Valley Water relies on groundwater for a significant portion of the county's water supply, particularly in South County where groundwater provides more than 90% of

supply for all beneficial uses and 100% of the drinking water supply. Valley Water manages groundwater in conjunction with surface water to reliably meet the county's water demands now and in the future.

As described previously, significant subsidence occurred historically in the Santa Clara Plain due to chronic overdraft but was essentially halted by about 1970 through Valley Water's expanded conjunctive management programs. Valley Water's goal of minimizing land subsidence is combined with the water supply reliability goal since the actions taken to address one also addresses the other. Preventing additional permanent subsidence has been a major driver for Valley Water over its history given the extremely high costs associated with reduced carrying capacity of flood control structures, damage to infrastructure, and seawater intrusion.

5.2.2 Groundwater Quality Protection

Goal: Aggressively protect groundwater from the threat of contamination.

While surface water goes through significant treatment processes before being served as drinking water, groundwater from the Santa Clara and Llagas subbasins is generally of high quality and public water supply wells typically do not require any treatment other than disinfection. Although Valley Water does not serve groundwater directly to consumers, as the local groundwater management agency Valley Water works to ensure that the groundwater used by the residents and businesses of Santa Clara County is of reliably high quality.

In highly urbanized areas such as the Bay Area, there are numerous threats to groundwater quality including urban runoff, industrial chemical spills, illegal dumping, and leaking underground storage tanks. Agricultural and residential use of pesticides and nitrogen-based fertilizers can also impact groundwater quality. As surface water percolates through soil layers, some natural filtration occurs; however, this natural process is not effective for all contaminants.

Groundwater degradation may lead to costly treatment or even make groundwater unusable, resulting in the need to secure additional supplies. Preventing groundwater contamination is more cost effective than cleaning up polluted groundwater, a process that can take many decades depending on the nature and extent of the contamination. Notable contamination sites in the county requiring significant groundwater cleanup include large solvent releases at the IBM and Fairchild sites in south San Jose in the 1980s and the Olin perchlorate release in Morgan Hill, which was discovered in the early 2000s.

Historically, seawater intrusion has been observed in the shallow aquifer zone of the Santa Clara Subbasin adjacent to San Francisco Bay during periods of higher groundwater pumping and land subsidence. Significant increases in groundwater pumping or sea level rise due to climate change could lead to renewed seawater intrusion.

The goal of Valley Water's groundwater quality protection programs is to ensure that groundwater is a viable water supply for current and future beneficial uses. In addition to the principal, deep drinking water aquifers, Valley Water works to protect the quality of all aquifers. Although not typically used for beneficial purposes, shallow groundwater is also a potential future source for drinking water or other beneficial use.

Section 5 of the District Act authorizes Valley Water to prevent the pollution and contamination of Valley Water surface water and groundwater supplies. This sustainability goal is consistent with the District Act and with Board Water Supply Objective 2.2.2.

5.3 BASIN MANAGEMENT STRATEGIES

The basin management strategies are the methods that will be used to meet the sustainability goals. Many of these strategies have overlapping benefits to groundwater resources, acting to improve water supply reliability,

minimize subsidence, and protect groundwater quality. The strategies are listed below and described in detail in this section.

1. Manage groundwater in conjunction with surface water.
2. Implement programs to protect and promote groundwater quality.
3. Maintain comprehensive, adaptive groundwater models and monitoring networks.
4. Work with regulatory and land use agencies to protect recharge areas and prevent groundwater contamination.

Strategy 1: Manage groundwater in conjunction with surface water.

The desired goal of this strategy is to have a sustainable, reliable groundwater supply and minimize the potential for seawater intrusion and land subsidence. The primary mechanisms for implementing this strategy are Valley Water's managed and in-lieu recharge programs. The county relies on local groundwater subbasins to help meet water demands, naturally transmit water over a wide area, and provide critical storage reserves for emergencies such as droughts or other outages. Because groundwater pumping far exceeds what is replenished naturally, Valley Water manages groundwater and surface water in conjunction to ensure the groundwater subbasins remain an important component in meeting current and future water demands.

Maintaining Valley Water's comprehensive managed recharge program using both local and imported waters is critical to sustaining groundwater supplies and avoiding chronic overdraft conditions, subsidence, and other undesirable results. This requires maintaining local water rights, water supply sources, and existing recharge facilities. The strategy also relies on developing additional recharge facilities and sources to help support future needs as identified in Valley Water's Water Supply Master Plan 2040. Currently, several of Valley Water reservoirs have restricted storage capacity due to limitations imposed by Division of Safety of Dam (DSOD) and dam safety directives from the Federal Energy Regulatory Commission (FERC). For example, to increase the seismic stability of Anderson Dam, Valley Water drained Anderson Reservoir to deadpool (3% of capacity and the lowest level that can be reached through releases from the existing outlet pipe) beginning in October 2020, to prepare for the reconstruction of the existing earthen Anderson Dam. The reconstruction is expected to last about 10 years and will allow Anderson Reservoir to return to its full operating capacity once completed. Resolving dam safety issues that currently restrict reservoir storage is also an essential component of this strategy.

Just as important as managed recharge are Valley Water's treated and raw water deliveries, and water conservation and water recycling programs, as well as the availability of SFPUC supplies to the county. These activities provide in-lieu recharge by reducing the need for pumping through direct deliveries of other supplies and reduced water supply demands. Along with managed recharge, these activities help to maintain adequate groundwater storage, keep groundwater levels above subsidence thresholds and maintain flow gradients. In turn, adequate groundwater storage supports groundwater pumping and minimizes risks related to land subsidence and seawater intrusion. Valley Water's managed and in-lieu recharge programs are described in detail in Chapter 6.

Strategy 2: Implement programs to protect and promote groundwater quality.

Groundwater in Santa Clara County is generally of very high quality, with few public water systems requiring treatment beyond disinfection prior to delivery to customers. Valley Water evaluates groundwater quality and potential threats so that changes in groundwater quality can be detected and appropriate action can be taken to protect the quality of groundwater resources. This includes assessing regional conditions and trends, evaluating threats to groundwater quality including emerging contaminants, conducting technical studies such as vulnerability assessments, and implementing strategies to protect groundwater from contaminant sources.

Because Valley Water does not have regulatory or land use authority, this strategy is focused on identifying potential concerns through monitoring and analysis and implementing programs to reduce contaminant loading or consumer

exposure. A recent example is voluntary regional Valley Water sampling for Per- and Polyfluoroalkyl Substances (PFAS) to evaluate the presence in local groundwater. While results indicate that PFAS are not widely present above current State Board health-advisory levels, several water supply wells in the Santa Clara Plain with PFAS detections have been taken offline by a water retailer out of an abundance of caution. Valley Water is actively engaging with regulatory agencies and local water retailers to better understand potential sources and to take action if needed to ensure a safe and reliable drinking water supply. Other efforts to coordinate with land use and regulatory agencies are described in Strategy 4 below. Groundwater protection programs are described in detail in Chapter 6.

Strategy 3: Maintain and develop adequate groundwater models and monitoring networks.

Monitoring programs provide critical data to understand groundwater conditions and support operational decisions, including the timing and location of managed recharge. Valley Water has implemented programs to regularly monitor groundwater levels, groundwater quality (including monitoring near recycled water irrigation sites), recharge water quality, surface water flow, and land subsidence. Local water retailers also monitor groundwater levels and test groundwater quality for compliance with DDW regulations. Data from these programs is essential to evaluating current conditions and trends, preventing groundwater overdraft and subsidence, and measuring the effectiveness of basin management programs and activities. These monitoring programs and related monitoring protocols are described in Chapter 7.

Valley Water has also developed models to support operational decisions and long-term planning. These include operational and water supply system models, as well as groundwater flow models. Valley Water has developed calibrated groundwater flow models for the Santa Clara Plain, Coyote Valley, and the Llagas Subbasin, which are used to evaluate groundwater storage and levels under various operational and hydrologic conditions. These models are used to support decisions on recharge and other water supply operations, the evaluation of potential projects, and long-term water supply planning. Maintaining calibrated models that can reasonably forecast groundwater conditions is an important part of Valley Water's groundwater management strategy.

Strategy 4: Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

Since the 1950s, land use in the Santa Clara Plain has changed from largely rural and agricultural to a highly developed urban area. The increased amount of land covered by impervious materials has increased surface water runoff and reduced natural recharge. Although not as urbanized as the Santa Clara Plain, the Llagas Subbasin serves the growing cities of Morgan Hill and Gilroy, and significant development has been considered in the Coyote Valley. This strategy calls for working with land use agencies to maximize natural recharge by protecting groundwater recharge areas and supporting the use of low-impact development.

Increased urbanization also increases the risk of contamination, particularly in groundwater recharge areas that are more vulnerable due to the presence of highly permeable sediments. Valley Water coordinates with land use agencies on potentially contaminating land use activities and resource protection by reviewing certain land use proposals, General Plans, and engaging in policies and projects related to groundwater. Regulatory agencies play a critical groundwater protection role by establishing water quality objectives and overseeing the cleanup of contaminated sites. Valley Water will continue to work with these agencies and identify opportunities for enhanced cooperation to minimize impacts from existing contamination and prevent additional contamination from occurring. This includes the development of technical studies, participation in policy development, and coordination on proposed development.

5.4 OUTCOME MEASURES

This section describes key performance measures in meeting the following sustainability goals: (1) Manage groundwater to ensure sustainable supplies and avoid land subsidence; and (2) Aggressively protect groundwater from the threat of contamination.

The outcome measures are quantifiable goals to track performance of sustainable management and are functionally equivalent to measurable objectives under SGMA. This 2021 GMWP has new outcome measure-lower thresholds that are quantifiable values used to define undesirable results and are functionally equivalent to minimum thresholds under SGMA. The outcome measure-lower thresholds account for a reasonable margin of operational flexibility[81] below the outcome measures that accommodates drought, climate change, conjunctive use operations, and other groundwater management activities. Valley Water has a long-established history of sustainable groundwater management and will continue to proactively manage groundwater to minimize the risk of reaching the outcome measure-lower thresholds and related undesirable results. The basis for these outcome measures and corresponding outcome measures-lower thresholds and a description of how they will be measured is presented below.

5.4.1 Groundwater Storage

Outcome Measure: Projected end of year groundwater storage is greater than 278,000 acre-feet (AF) in the Santa Clara Plain, 5,000 AF in the Coyote Valley, and 17,000 AF in the Llagas Subbasin.

Outcome Measure – Lower Threshold: Projected end of year countywide groundwater storage is greater than Stage 5 (150,000 AF) of the Water Shortage Contingency Plan

Groundwater storage is a critical consideration in water supply reliability and is the county's best protection against drought or facility outage. The end of year groundwater storage is projected to support operational decisions, including the timing and location of reservoir releases and managed recharge, and decisions related to imported water such as short-term water exchanges or out of county banking.

Valley Water's 2020 Urban Water Management Plan[82] contains a water shortage contingency plan that uses groundwater storage to indicate potential water shortages and outlines the overall strategy for dealing with water shortages, including contingency actions. The "normal" stage where no contingency action is needed occurs when the projected end of year groundwater storage is above 300,000 AF in the Santa Clara and Llagas subbasins combined.

While the 2020 UWMP provides an overall storage target of 300,000 AF in both the Santa Clara and Llagas subbasins, more specificity is needed with regard to the management of individual subbasins and groundwater management areas. Based on groundwater storage observed historically, the end of year storage targets established in this GWMP are 283,000 AF in the Santa Clara Subbasin (278,000 AF in the Santa Clara Plain and 5,000 AF in the Coyote Valley) and 17,000 AF in the Llagas Subbasin.

From 2010 to 2019, countywide groundwater storage in the Santa Clara and Llagas subbasins remained in the normal stage (>300,000 AF) each year except during the 2012–2016 drought when storage dipped into stage 3 during 2014 and 2015. Despite this drop in storage, there were very limited impacts to well users, with fewer than 15 reports of wells going dry for domestic wells along the basin margins where well yield is more uncertain (Appendix D). No permanent subsidence was observed. Due to Valley Water's recharge programs, coordination

[81] California Department of Water Resources, 2017, Best Management Practices for the Sustainable Management of Groundwater, Sustainable Management Criteria BMP, 36 pages.
[82] Santa Clara Valley Water District, Urban Water Management Plan, 2020

with water retailers, and community water use reductions in response to Board action, groundwater storage quickly recovered to the normal stage (stage 1) in 2016. Therefore, to account for a reasonable operational flexibility, including more severe future droughts or infrastructure outages, the outcome measure-lower threshold for groundwater storage in the Santa Clara and Llagas subbasins is greater than stage 5 (150,000 AF) of the water shortage contingency plan. If storage falls below this target, there would be a greatly increased risk of resumed permanent subsidence and more widespread reports of dry wells. The outcome measure-lower threshold accounts for the integrated groundwater management and operational decisions that are necessary for Valley Water to make across both Santa Clara and Llagas subbasins, particularly during a drought response.

5.4.2 Groundwater Levels and Land Subsidence

Outcome Measure: Groundwater levels are above subsidence thresholds at the Santa Clara Subbasin subsidence index wells.

Outcome Measure – Lower Threshold: Groundwater levels are above the historical low water levels at the majority of the Santa Clara Subbasin subsidence index wells.

Significant inelastic (permanent) land subsidence occurred in the Santa Clara Plain through the 1960s due to long-term overdraft. Permanent subsidence was essentially halted by about 1970 through Valley Water's expanded conjunctive use programs, which allowed a substantial recovery in groundwater levels. The avoidance of inelastic land subsidence has been and continues to be a major driver for Valley Water given the extremely high costs associated with damaged infrastructure, reduced carrying capacity of flood control structures, and seawater encroachment into freshwater aquifers. It is critical to prevent inelastic subsidence because it is irreversible.

In 1991, Valley Water evaluated the remaining land subsidence potential to avoid additional inelastic subsidence due to groundwater overdraft.[83] Based on the findings of this study, Valley Water has established an acceptable subsidence rate of no more than 0.01 feet per year on average, measured over a multi-year period. This rate was presented to and endorsed by the Water Retailer Groundwater Subcommittee following the 1991 study, and the related subsidence thresholds have been used historically to measure performance in meeting Board policy. Monitoring data indicates that the subsidence target has generally been met. Ten index wells throughout the Santa Clara Subbasin were selected as control points for subsidence model calibration and prediction and the tolerable rate of 0.01 feet per year of inelastic subsidence was applied to determine threshold groundwater levels for these wells. These subsidence thresholds (Table 5-1) are the groundwater levels that must be maintained to ensure a low risk of unacceptable land subsidence.

This outcome measure relies on continued observation of groundwater levels at the subsidence index wells and comparison to subsidence thresholds to ensure groundwater levels are maintained above these thresholds (Table 5-1). It should be noted that a few wells shown in Table 5-1 differ from those in the 1991 study due to well destruction or loss of access. Replacement wells are chosen such that they are in close proximity to and display similar water level patterns as the original well.

[83] Geoscience Support Services Inc. for Santa Clara Valley Water District, Subsidence Thresholds in the North County Area of Santa Clara Valley, 1991.

Table 5-1. Subsidence Thresholds

Subsidence Index Well Number	State Well ID	Location	Subsidence Threshold Elevation (feet above mean sea level, NAVD 88)	Historical Low Groundwater Elevation (feet above mean sea level, NAVD 88)
1	08S01W03K013	Near Division St./Dell Ave. in Campbell	169	166
2	08S01E05N002	Near Jarvis Ave./Gerlach Dr. in south San Jose	-20	25
3	07S01E02J021	Near Story Rd./McGinness Ave. in east San Jose	-143	-54
4	06S01W24H015	Near Montague Expy/Seely Ave. in Milpitas	-15	-141
5	07S01W22E002	Near San Tomas Expy/Williams Ave. in west San Jose	-42	-189
6	07S01W08D003	Near Kensington Ave./Lochinvar Ave. in Santa Clara	-44	-148
7	06S02W22G005	Near Middlefield Rd./Tyrella Ave. in Mountain View	-23	-95
8	06S02W24C010	Near Hwy 101/Hwy 237 in Sunnyvale	-27	-77
9	07S01W02G024	Near El Camino Real/Benton St. in Santa Clara	-32	-123
10	07S01E16C006	Near Hwy 280/12th St. in downtown San Jose	-37	-134

Notes: NAVD 88 is the North American Vertical Datum of 1988.
Subsidence thresholds are rounded to one foot.
Subsidence index wells 2 and 3 have subsidence threshold elevations lower than the historical low groundwater elevations due to the local geology and the minimal historical subsidence at those locations (Geosciences Support Services, 1991).

From 2010 to 2019, groundwater levels at all 10 subsidence index wells remained above their respective subsidence threshold elevations except during the 2012–2016 drought when water levels temporarily dropped below the subsidence threshold at one well (07S01W22E002) during the summer and fall of 2014. Because the water levels at two other index wells (07S01W02G024 and 07S01E16C006) were also approaching their respective thresholds, Valley Water worked with several water retailers to reduce groundwater pumping in these areas. Due

to this coordinated effort, Valley Water's recharge programs, and community water use reduction, the groundwater levels at 07S01W22E002 quickly recovered to levels above the subsidence threshold in early 2015 despite continued dry conditions. Water levels at the other nine subsidence index wells had a similar response and water levels rose to healthy levels above the subsidence thresholds.

As documented in Valley Water's 2019 annual groundwater report, there was some elastic (recoverable) subsidence, but no inelastic (permanent) subsidence during the 2012–2016 drought in the Santa Clara Subbasin based on Valley Water's land survey and extensometer monitoring. Because of the enormous potential community costs from resumed land subsidence in the Santa Clara Plain, the outcome measures are conservative to ensure a continued low risk of permanent subsidence. To account for a reasonable operational flexibility, including more severe future droughts or infrastructure outages, the outcome measure-lower threshold for subsidence is that groundwater levels remain above the historical low water levels at the majority of the Santa Clara Subbasin subsidence index wells. If groundwater levels fall below historical low levels, widespread, permanent subsidence will resume. The outcome measure-lower threshold accounts for short-term and localized water levels dropping below the subsidence thresholds, which may not result in inelastic subsidence across the Santa Clara Subbasin. Elastic subsidence is observed annually, and unless water levels fall below historical lows, it is uncertain if observed subsidence is elastic or inelastic while it is happening. That can only be analyzed after water levels have recovered to determine whether there was complete rebound. During the next five-year GWMP update cycle, Valley Water will evaluate the maximum magnitude and duration that water levels can drop below subsidence thresholds without resulting in inelastic subsidence.

5.4.3 Water Quality

Outcome Measure: For Santa Clara Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).

Outcome Measure – Lower Threshold: At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.

Outcome Measure: For Llagas Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).

Outcome Measure – Lower Threshold: At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.

Based on DWR Recommended Actions (Appendix C) the water quality outcome measures in the 2021 GMWP include new and separate outcome measures and corresponding outcome measures-lower thresholds related to groundwater quality in the Santa Clara and Llagas subbasins. These separate subbasin-specific criteria will allow for a determination of whether each subbasin, separately, is meeting or making progress toward the outcome measures. Additionally, the new water quality outcome measure for the Santa Clara Subbasin is distinctly different than the new outcome measure for seawater intrusion in the subbasin, as described below.

Water supply reliability depends on maintaining both an adequate supply of water and protecting water quality. While surface water goes through significant treatment before being served as drinking water, groundwater from public water supply wells is of high quality and does not typically require wellhead treatment beyond disinfection before being delivered to consumers. Protecting groundwater quality is critical for ensuring clean safe water for well users and avoiding the need for treatment. The Santa Clara and Llagas subbasins have good water quality overall, but maintaining that quality is not without its challenges. Threats to groundwater quality come from a

variety of sources and include urban, rural, and agricultural activities. Elevated nitrate is widespread throughout the South County, and there are a few detections above maximum contaminant levels each year for other parameters such as perchlorate and aluminum. Public water suppliers, like water retailers, regularly test water quality to ensure water being delivered to homes and businesses meets all state and federal water quality standards. Private well owners are not required to regularly test their water quality and therefore may not be aware of the quality of water from their wells or the presence of contaminants above health-based standards.

To protect the quality of groundwater for beneficial uses, the water quality outcome measures evaluate the percentage of water supply wells that meet all primary MCLs. These outcome measures will be evaluated annually using data collected at water supply wells sampled by Valley Water and water retailers. Data from dedicated monitoring wells will not be used as it is less representative of water being pumped for beneficial use.

The target percentage for water supply wells meeting primary MCLs is set high (95%) since these are health-based regulatory standards that must be met by public water systems. This measure is not set at 100% for several reasons. Some of the wells monitored by Valley Water are private domestic wells, which are assumed to have less stringent wellhead protection, maintenance, and testing. The water quality at these wells may be more influenced by local land use and conditions near the well as they are typically shallower than public water supply wells. Also, DDW does not consider a single detection of a contaminant to be indicative of contamination and would not consider a single detection to be an actual finding without a follow-up detection. Water served to customers may not have had the contaminant present at that concentration since water systems may perform treatment or blending prior to service.

The timely identification of adverse trends is important so that appropriate action can be taken to protect groundwater resources. Therefore, the outcome measures also evaluate long-term trends in TDS on an annual basis using 15 years of data from water supply wells. TDS is an indicator of salt loading and overall groundwater quality conditions. The salts from applied irrigation water remain in the soil layer and can eventually be leached into groundwater by rainfall or over-irrigation. The trend-based component of the outcome measures will help Valley Water to better understand how groundwater quality is changing over time and highlight areas that may warrant further study or action to protect the beneficial use of groundwater.

The water quality outcome measures evaluate combined trends in both shallow and principal aquifer zone supply wells for each subbasin because changes in shallow wells might be detectable before changes appear in deeper wells. The outcome measure uses a target percentage of 90% to serve as a broad indicator of trends in these parameters, while recognizing that groundwater quality can fluctuate at any given well over time due to hydrology, pumping, or other factors. Also, the mere presence of a statistically significant increasing trend does not necessarily indicate a problem; the magnitude of change also needs to be considered. While the target percentage of 90% will serve as an overall indicator of trends in groundwater quality, the magnitude of the trend will also be evaluated to identify potential areas of concern so that additional action can be taken if necessary to protect groundwater resources.

If a water-quality parameters do not meet the outcome measure, it is important that the overall concentration trends are either stable or decreasing with time to avoid widespread degradation of groundwater quality. The water quality outcome measure-lower thresholds focus on nitrate and TDS trends as key water quality indicators. Nitrate is the one parameter that is frequently detected above the MCL and affects the largest number of wells, particularly in the southern Santa Clara Subbasin (Coyote Valley) and across the Llagas Subbasin. Common sources of nitrate in groundwater are synthetic fertilizers, septic systems, and animal wastes. Elevated nitrate is common in the Llagas Subbasin and parts of the Coyote Valley due to historic and ongoing sources; however, there are also localized areas with nitrate concerns in the northern Santa Clara Subbasin. Recent trends show that about 85% to 95% of supply wells have stable or decreasing nitrate concentrations, indicating that while elevated nitrate still

exists, the trends in most wells are not getting worse. A high fraction of wells with increasing trends in either nitrate or TDS would indicate widespread degradation of groundwater quality, which could negatively impact many well users. To account for reasonable operational flexibility, including annual factors that can affect groundwater quality, the outcome measure-lower threshold for groundwater quality is that at least 70% of supply wells have stable or decreasing concentrations of nitrate and TDS.

5.4.4 Seawater Intrusion

Outcome Measure: In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than the historical maximum extent area (57 square miles).

Outcome Measure – Lower Threshold: In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than 81 square miles, which represents a one-mile radial buffer of the historical maximum extent area.

This 2021 GWMP includes a new seawater intrusion outcome measure for the Santa Clara Subbasin. A detailed technical memorandum that documents the current understanding of seawater intrusion mechanisms, approach, and analysis used to develop the seawater intrusion outcome measure is included in Appendix H. Appendix H also documents current understanding of climate change driven sea-level rise and implications for monitoring and managing seawater intrusion in the Santa Clara Subbasin.

Valley Water has been monitoring groundwater quality in the Santa Clara Subbasin for decades. Chloride data from wells screened in the shallow aquifer zone was presented as the 100 mg/L chloride isocontour in the 2016 GWMP and in Valley Water's Annual Groundwater Report. This concentration is used as an early warning of potential seawater intrusion since the SMCL for chloride is 250 mg/L. Figure 5-3 is a compilation of available 100 mg/L isocontours that have been presented in recent Valley Water reports, spanning the years from 1945 to 2019. Figure 5-3 indicates that the maximum known extent of SWI (denoted by the 100 mg/L chloride isocontour) occurred around 1960, which coincided with groundwater overdraft conditions and historic low groundwater levels throughout much of the Santa Clara Subbasin. It is important to note that the furthest inland lobe of the 100 mg/L chloride isocontour occurred around 1960 and again in 1999 and 2002 near the Guadalupe River and Coyote Creek (Figure 5-3). This further supports the leakance of saltwater from tidal stream flow as a relatively major influence on the spatial extent of SWI in the shallow aquifer zone. The maximum known extent of the 100 mg/L chloride isocontour in 1960 covered an area of about 57 square miles as compared to only 40 square miles in 2019. Additional details of the historical progress of the 100 mg/L chloride isocontours are presented in Appendix H.

The number and location of supply wells were evaluated in relation to the 100 mg/L isocontours to identify an appropriate outcome measure and outcome measure-lower threshold. Most supply wells are screened in the deeper, principal aquifer zone, where no widespread SWI has been observed (Appendix H). The 100 mg/L chloride isocontours are based on monitoring wells screened in the shallow aquifer zone and thus represent potential vulnerability of contamination of the deeper, principal aquifer, via improperly constructed or destroyed wells that may serve as vertical conduits for poorer quality water from the shallow zone. See Appendix H for additional details about the number and location of supply wells within the maximum know extent of 1960 and radial buffers of the 100 mg/L chloride isocontour.

The new SWI outcome measure is based on the 57 square miles of the historical maximum extent of SWI (100 mg/L chloride isocontour) in the 1960s (Figure 5-4). This is a conservative approach since the 100 mg/L concentration is below the MCL and because no widespread impacts to water supply wells were associated with the maximum extent of SWI. To account for a reasonable operational flexibility, including annual variability in the spatial extent of the 100 mg/L chloride isocontour, especially near the Guadalupe River and Coyote Creek, the new SWI outcome

measure-lower threshold is based on the 1 mile (5,280 feet) radial buffer of the historical maximum extent of SWI (100 mg/L chloride isocontour) in the 1960s (Figure 5-4). The maximum known extent and the 5,280-foot radial buffer have a combined total of 49 active wells that pump 1,558 AF, which is equivalent to only about 1.7% of the total groundwater pumping in the Santa Clara Subbasin in 2013 (Appendix H). Using the 5,280-foot buffer as a lower threshold to the outcome measure will help minimize the risk of SWI vulnerability to supply wells in the Santa Clara Subbasin.

Figure 5-3. Historical 100 mg/L Chloride Isocontours in the Shallow Aquifer Zone of the Santa Clara Subbasin

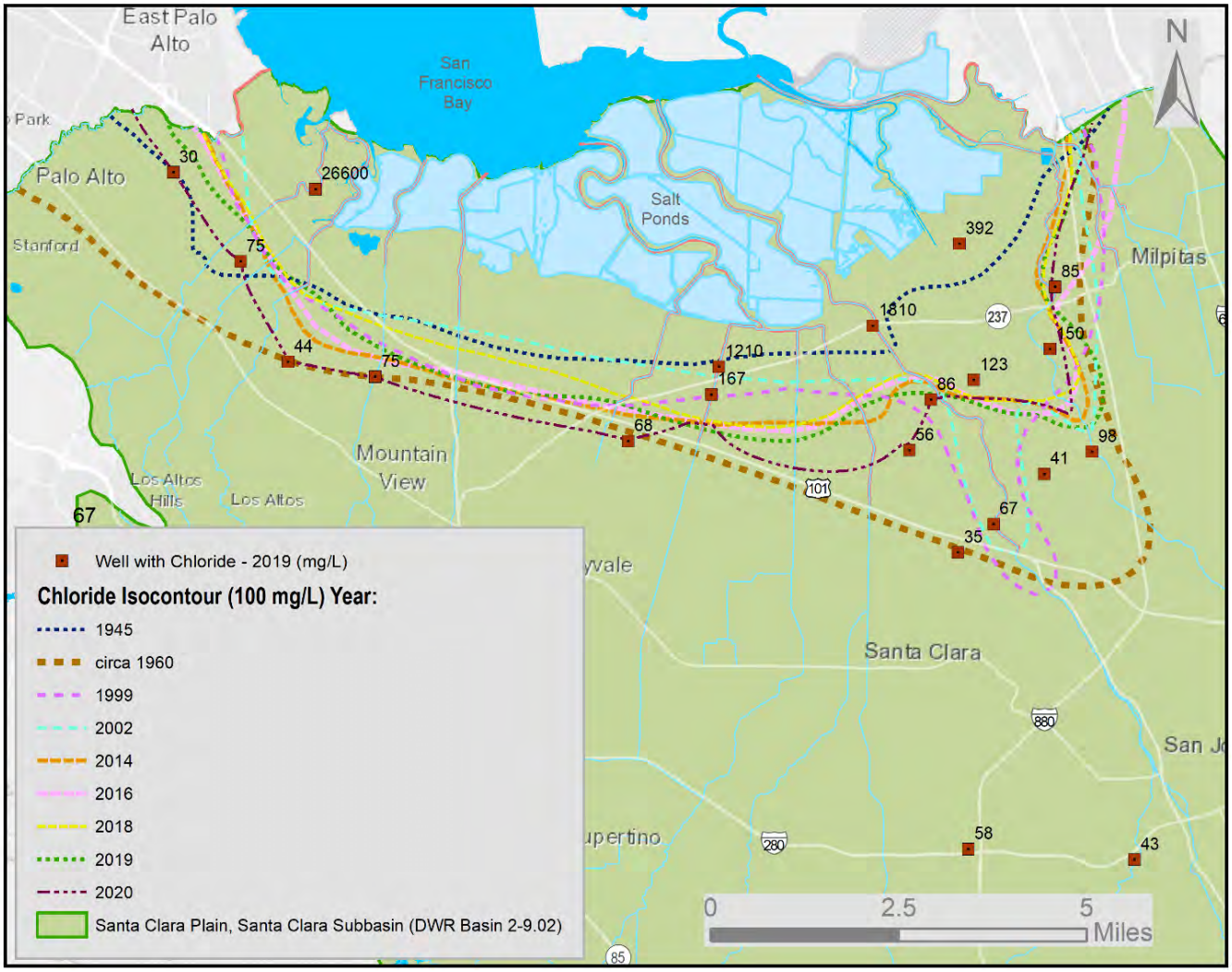


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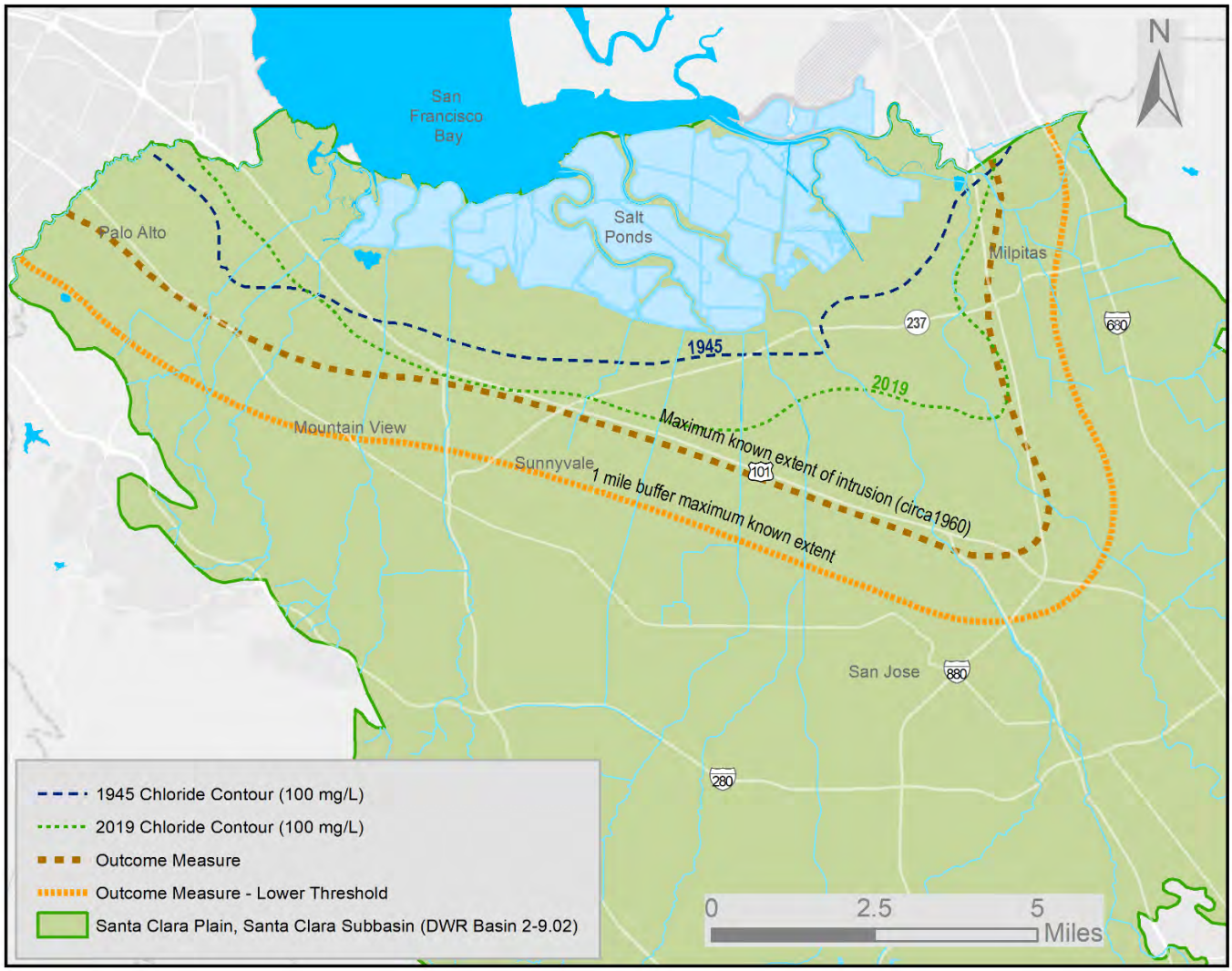
Figure 5-4. Seawater Intrusion Outcome Measure and Outcome Measure-Lower Threshold



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CHAPTER 6 – BASIN MANAGEMENT PROGRAMS AND ACTIVITIES

As a GSA, Valley Water's programs to protect and augment water supplies are implemented under SGMA and powers granted by the District Act[84], which authorizes Valley Water to provide comprehensive water management for all beneficial uses within Santa Clara County. The District Act authorizes Valley Water to take the following actions to protect and augment water supplies:

- Conserve and manage water for beneficial and useful purposes, including spreading, storing, retaining, and groundwater recharge.
- Protect, save, store, recycle, distribute, transfer, exchange, manage, and conserve water.
- Increase and prevent the waste or diminution of the water supply.
- Obtain, retain, protect, and recycle water for beneficial uses.
- To do any and every lawful act necessary to be done that sufficient water may be available for any present or future beneficial use or uses of the lands or inhabitants within the district.

Valley Water has many programs and activities that protect groundwater supplies and quality. Other agencies also implement programs to protect groundwater resources in the county. This chapter describes programs developed to maintain a reliable water supply, prevent inelastic (permanent) land subsidence, and protect groundwater quality, both now and in the future. Monitoring programs are described in Chapter 7.

In addition to the programs described in this chapter, Valley Water monitors emerging policies and regulations, collaborates with key decision makers and stakeholders to effect policy change, cultivates relationships, and works with federal, state, and local government representatives on pending legislation and regulatory standards related to the protection of groundwater resources. The purpose of these activities is to ensure that Valley Water interests are communicated and considered in legislative and regulatory processes.

This chapter focuses on operations projects or ongoing basin management activities programs implemented by Valley Water and other agencies. Valley Water also implements capital projects as needed to protect and augment groundwater resources. These projects are described in Valley Water's Capital Improvement Program.[85]

6.1 PROGRAMS TO MAINTAIN A RELIABLE GROUNDWATER SUPPLY

The Santa Clara and Llagas subbasins are a critical component of the overall water supply of Valley Water. Valley Water manages water resources, including groundwater and imported water, and wholesales treated water to water retailers in Santa Clara County to achieve overall water supply reliability. By maintaining groundwater levels and sufficient storage, these programs prevent undesirable results including long-term groundwater overdraft, inelastic land subsidence, and seawater intrusion. Related programs and activities are described in detail below.

6.1.1 Managed Recharge

To offset groundwater withdrawals and ensure the long-term sustainability of groundwater resources, Valley Water replenishes the Santa Clara and Llagas subbasins with local and imported surface waters in Valley Water recharge facilities. This section focuses on managed recharge operations. However, it should be noted that the managed recharge program depends upon many other Valley Water programs, including programs related to dam maintenance, the administration and management of imported water contracts, local water rights management,

[84] Santa Clara Valley Water District Act, Water Code Appendix Chapter 60.
[85] Santa Clara Valley Water District, 5-Year Capital Improvement Program, 2012-2026.

groundwater analysis, and maintenance of the raw water conveyance system and groundwater recharge facilities.

By releasing locally conserved and imported water from local reservoirs or Valley Water's raw water distribution system, Valley Water significantly increases groundwater recharge. On average, Valley Water's managed recharge program replenishes twice the amount of water replenished naturally. Valley Water recharge facilities are designed for rapid infiltration based on their permeability and hydraulic characteristics. Through Valley Water's managed recharge operations, an average of about 88,500 AF was recharged annually between 2010 and 2019 and about 85,000 AF in 2019. This water came from a variety of sources, including watershed stormwater runoff captured in the county's 10 local reservoirs and water imported from both the State Water and Central Valley projects. Managed recharge was scaled back during the 2012–2016 drought due to limited surface water availability. During the peak of the drought in 2014 and 2015, annual managed recharge was around 26,000 AF and 54,000 AF, respectively. In 2016, Valley Water substantially increased managed recharge to about 140,000 AF to help recover groundwater storage that had decreased during the drought. During periods of limited surface water availability, priority for managed recharge is typically given to highly groundwater-dependent areas such as the Coyote Valley and Llagas Subbasin.

Recharge facilities are closely monitored using a computerized control system and field observation. The raw water control system provides for remote operation of water distribution facilities and real-time system performance data. Water resources technicians perform daily inspections of recharge facilities and record flows and water levels. Operations include daily monitoring of forecasts, reservoir inflows, and storage levels to plan releases for water supply operations, dam safety and bank stability, habitat management, and flood potential reduction. A detailed description of Valley Water's managed recharge facilities is summarized in Appendix I.

6.1.1.1 Reservoirs and Diversions

Valley Water constructed 10 reservoirs and has five active stream diversions to enable appropriation of water supplies under Valley Water's water rights. The primary function of Valley Water's surface water reservoirs is to store local and imported water for groundwater recharge and treatment plant deliveries for water supply. Dams are operated under certificates of approval from the California Department of Water Resources, Division of Safety of Dams and reservoirs and diversions are operated in accordance with the California Fish and Game Code. Total storage capacity of Valley Water's reservoirs is 166,000 acre-feet. Valley Water is currently assessing the seismic stability of its reservoirs, and several reservoirs are currently subject to operating restrictions that reduce reservoir storage capacity until upgrades are implemented. For example, to increase the seismic stability of Anderson Dam, Valley Water drained Anderson Reservoir to deadpool (3% of capacity and the lowest level that can be reached through releases from the existing outlet pipe) beginning in October 2020, to prepare for the reconstruction of the existing earthen Anderson Dam. The reconstruction is expected to last about 10 years and will allow Anderson Reservoir to return to its full operating capacity once completed. These operating restrictions may impact groundwater recharge for facilities that depend on local water supplies since the amount of local water that can be captured is reduced. Additionally, the reservoirs are operated for flood risk reduction and many include safety operational guidelines that limit storage during winter.

Most of the stored water released from the reservoirs is delivered to streams below the dams. As the water flows downstream, some of it percolates through the streambed and recharges the groundwater subbasins. Some water may be diverted downstream for recharge in off-stream recharge facilities. Valley Water also operates and maintains several systems that divert water to recharge facilities and enhance recharge. Additional detail on Valley Water recharge facilities is in Appendix D.

6.1.1.2 In-Stream Managed Recharge

Valley Water conducts in-stream managed recharge operations in more than 91 miles of stream channel (Appendix I). About two-thirds of Valley Water's managed recharge occurs through in-stream recharge facilities, with over 60,000 AF recharged from Valley Water releases into creeks in most years. In 2015, a drought year, in-stream managed recharge was reduced to about 35,800 AF. After the 2015 drought, in-stream recharge was back to normal and the 2018 and 2019 in-stream recharge was about 64,900 and 67,600 AF, respectively. In addition to ongoing planning, monitoring, and inspection of facilities, Valley Water also coordinates operations for flashboard dams with the California Department of Fish and Wildlife (CDFW) under related agreements.

Valley Water recharge operations along streams have been modified in recent years to reflect environmental concerns, including the protection of aquatic habitats. In 1996, the Guadalupe-Coyote Resource Conservation District (GCRCD) filed a complaint with the State Water Board alleging that Valley Water's water supply operations impact fish and aquatic habitat in Coyote and Stevens creeks, and the Guadalupe River tributaries.

In 2003, settlement negotiations with GCRCD as well as the National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (FWS), CDFW, and other interested non-governmental organizations resulted in the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) settlement agreement. The agreement set forth a pathway to resolve the water rights complaint through changes to Valley Water reservoir operations, scientific studies, and restoration measures. Since then, through early implementation, Valley Water has moved forward with restoration measures to improve fish habitat in Coyote and Stevens creeks, and the Guadalupe River tributaries in north Santa Clara County that flow to San Francisco Bay, consistent with Board policies. To date, Valley Water has remediated 10 of the 18 priority fish barriers named in the settlement agreement to improve fish passage. In addition, Valley Water's water diversions have been screened. Valley Water has allocated funding for additional fish barrier removal projects and has been collecting habitat and fish data to further support fish and aquatic habitat restoration in Coyote Creek, Guadalupe River, and Stevens Creek watersheds.

In May 2015, Valley Water submitted 15 Petitions for Change to the State Water Resources Control Board to address the water rights in the FAHCE settlement agreement. The proposed change in the purpose of use from domestic and irrigation to municipal more accurately reflects current and future use of local water for groundwater recharge and conjunctive use. Following the publication of a Notice of Preparation (NOP) in 2015, and a scoping meeting in 2017, a Draft FAHCE Environmental Impact Review (EIR) for Phase 1 flow and non-flow measures under the FAHCE Settlement for the Stevens Creek and the Guadalupe River watersheds was released for public review on June 30, 2021. This EIR is a Program EIR that provides project level review for some project components. The flow and non-flow measures identified in FAHCE Phase 1 for Coyote Creek will be analyzed in the Anderson Dam Seismic Retrofit Project (ADSRP) EIR.

6.1.1.3 Off-Stream Managed Recharge

Valley Water conducts managed recharge operations in 101 off-stream recharge ponds that range in size from less than 1 acre to more than 20 acres. Recharge through off-stream ponds accounts for about a third of Valley Water's managed recharge, with over 30,000 AF of water delivered to recharge ponds in most years. In 2019, off-stream managed recharge was reduced to 17,000 AF due to high groundwater conditions and low pumping in the Santa Clara Plain. Ongoing maintenance of off-stream ponds is conducted by removing accumulated fine sediments to maintain optimal recharge rates.

6.1.1.4 Indirect Potable Reuse

In 2021, Valley Water completed a Countywide Water Reuse Master Plan (Reuse Plan) that outlines opportunities and strategies toward achieving up to 24,000 AFY for potable water reuse, which is planned to include managed

groundwater recharge at the Los Gatos Recharge System (LGRS). The first phase of this proposed 10 million gallon per day (MGD) project includes construction of a new advanced water purification facility (AWPF), water conveyance pipelines, lateral pipelines, and associated facilities. Valley Water's preferred project is to construct the AWPF on land owned by the City of San José immediately adjacent to the existing Silicon Valley Advanced Water Purification Center (SVAWPC). However, the AWPF may also be located in the City of Palo Alto. At either location, the project would generate purified water for recharge using advanced water purification processes, including microfiltration, reverse osmosis, and advanced oxidation (ultraviolet light-peroxide).

The project would provide a locally controlled, drought-resilient source of purified water for groundwater recharge in the Santa Clara Subbasin via the LGRS. This would increase water supply reliability for Santa Clara County, help ensure continued groundwater sustainability, and protect against land subsidence. An onsite pump station and an approximately 18-mile water pipeline would be constructed within existing roadways to convey the purified water to the existing LGRS located in the City of Campbell. A nominal capacity target of 10 MGD, with a hydraulic peak capacity of 12.5 MGD, is identified for this project. These capacities would generate 11,200 AFY of purified water for groundwater recharge, with the potential to generate up to 14,000 AFY depending upon source water availability.

6.1.1.5 Treated Groundwater Reinjection Program

Over the years, hundreds of thousands of acre-feet of groundwater have been extracted in Santa Clara County to control or mitigate contamination plumes caused by spills or leaks of hazardous materials. To facilitate the cleanup of contamination sites, protect groundwater resources, and minimize the discharge of local waters to storm drains or sanitary sewers, Valley Water adopted Resolution 94-84 to encourage the reuse or recharge of treated groundwater from groundwater contamination cleanup projects. This program includes the review of applications against specific criteria to ensure that groundwater quality is protected and provides a financial incentive for qualifying projects. The program criteria are stringent to ensure compliance with the District Act; most parties extracting groundwater for environmental remediation do not meet the criteria with only a few sites participating in this program since its inception.

6.1.1.6 Injection Well Pilot

Valley Water's San Tomas Injection Well is a full-scale pilot direct injection facility, with a capacity of 750 AFY. This facility is able to receive treated water from Valley Water's Rinconada Water Treatment Plant via Valley Water's Campbell Distributary. The injection well is not currently in operation.

6.1.2 In-Lieu Recharge

Valley Water's in-lieu recharge programs play a critical role in maintaining groundwater basin storage and preventing undesirable results by meeting water demand that would otherwise be met by groundwater pumping.

6.1.2.1 Treated Water Operations

Valley Water operates three drinking water treatment plants, which operate 24 hours a day, 7 days a week and provide in-lieu recharge by reducing groundwater demands. The Rinconada Water Treatment Plant, which was constructed in 1967, has a maximum flow rate of 80 million gallons per day (MGD) and a current expansion to 100 MGD. The Penitencia Water Treatment Plant was constructed in 1974 and has a maximum flow rate of 40 MGD. The Santa Teresa Water Treatment Plant can process 100 MGD and has been online since 1989. The long-term average treated water delivery is 109,000 AFY for the period 2010 to 2019. The annual treated water delivery ranges from a maximum of 136,000 AF in 2012 to a minimum of 92,000 AF in 2014 for the same period. During the peak of the last drought in 2014-2015, treated water delivery was about 93,000 AFY.

6.1.2.2 Groundwater Banking and Supplemental Water Supplies

Valley Water also stores imported water used for in-lieu and managed recharge in the Semitropic Groundwater Bank (Semitropic Bank) in Kern County for withdrawal when needed. Valley Water has engaged in this water banking and exchange program with the Semitropic Water Storage District since 1996 to help manage variability in Valley Water's SWP and CVP water supplies. Valley Water is one of the original banking partners and has purchased a 35% share of the original one million AF capacity, establishing the water district as one of the largest banking partners. The Semitropic Bank provides a place to store surplus water supplies that may be inexpensively secured in wet years for later withdrawal and use in dry years. Water may also be stored and retrieved in the same year, depending on operational needs, to minimize the risk of losing SWP and CVP water allocated to Valley Water.

The Semitropic Bank involves conveyance of Valley Water's SWP and/or CVP water to the bank, which operates a conjunctive use program. Valley Water has the right to store up to 350,000 AF of water in the Semitropic Bank and currently (2021) has approximately 290,000 stored in the bank. Due to the limited operational groundwater storage capacity of the local Santa Clara and Llagas subbasins, Valley Water's storage of water in the Semitropic Bank provides it a critical source of additional water storage. However, in a dry year, Valley Water is typically only able to withdraw approximately 31,500 AF from the Semitropic Bank.

Storage in the bank occurs when water is physically delivered to recharge ponds in Semitropic's service area, or when surface water deliveries are used by landowners overlying Semitropic's service area in-lieu of local groundwater pumping. The Semitropic Bank is located south, or "downstream", of Valley Water in the state's water delivery system. Therefore, return of stored water to Valley Water is accomplished by either exchange of Semitropic's right to a portion of Kern County Water Agency's (KCWA) SWP water or Semitropic physically pumps groundwater into the California Aqueduct conveyance system for use by DWR or other SWP contractors downstream. Valley Water return water is then delivered by DWR from imported water from the Delta that would have otherwise been delivered to KCWA or other SWP contractors.

Over the past 20 years, Valley Water has stored about 475,000 AF of water in the Semitropic Bank and withdrawn about 250,000 AF of supply. During the 2012–2016 drought, both Semitropic Bank withdrawals and the acquisition of supplemental imported water supplies helped to ensure groundwater sustainability in the Santa Clara and Llagas subbasins. Valley Water withdrew a total of approximately 143,000 AF of dry year supply from the Semitropic Bank during the 2012–2016 drought during a time when supplemental water supply was both scarce and expensive. Since the drought ended, deposits in the bank totaled approximately 168,000 AF between 2016 and 2019.[86] The Semitropic Bank has proven to be a valuable resource to help Valley Water manage wet year water supplies, and to provide critically important dry year supplies to meet drinking water treatment plant demands and to protect Santa Clara County's groundwater basin from overdraft and subsequent land subsidence.

If water supplies are insufficient to meet needs, Valley Water may also purchase transfer water or participate in exchanges to supplement its supplies; both transfer and exchange supplies are conveyed to Santa Clara County from the Delta. In the critically dry year of 2021, for instance, Valley Water purchased 58,000 AF of transfer supplies to maintain treatment plant deliveries and recharge to protect groundwater levels and reduce the risk of land subsidence.

6.1.2.3 Water Conservation

As outlined in the WSMP, Valley Water's long-term water conservation targets are 99,000 AFY by 2030 and 109,000 AFY by 2040. To achieve these aggressive long-term goals and the additional Water Conservation Act of 2009

[86] Santa Clara Valley Water District, FY 2020-21 Protection and Augmentation of Water Supplies.

requirements, Valley Water, in partnering with its retailers, has implemented nearly 20 different water conservation programs that use a mix of incentives and rebates, free device installation, home visits, site surveys, and educational outreach to reduce water consumption in homes, businesses, and agriculture. Recent program expansion includes a new gray water system rebate program and increased rebates for turf removal. These programs are designed to achieve sustainable, long-term water savings and are implemented regardless of water supply conditions. Valley Water's conservation program saved an estimated 76,000 AF of water in 2019.

6.1.2.4 Water Recycling

Recycled water is a locally controlled, drought resilient source of supply that is primarily used for non-potable uses such as landscape irrigation and industrial cooling. Valley Water partners with the four recycled water producers in the county to expand recycled water use. Approximately 17,200 AF of recycled water was used in 2019. According to the 2020 UWMP, about 33,000 AFY of 2040 demands are projected to be met with non-potable recycled water. Valley Water's Silicon Valley Advanced Water Purification Center, which uses microfiltration, reverse osmosis, and ultraviolet disinfection to produce up to 8 million gallons of purified recycled water a day, went on-line in 2014. Water from this facility is currently blended into existing recycled water provided by South Bay Water Recycling to improve overall recycled water quality for irrigation and industrial purposes. This facility also allows demonstration of advanced treatment technologies and sets the stage for planned potable reuse as described in Section 6.1.1.4.

6.1.3 Protection of Natural Recharge

Valley Water's managed recharge program augments natural recharge since natural replenishment is insufficient to meet groundwater demands. However, protecting natural recharge capacity is also important. Natural recharge is defined here as any type of recharge not controlled by Valley Water, including rainfall, subsurface seepage from surrounding hills, net irrigation return flows, net leakage from water distribution systems, storm drains, sewer lines, and septic systems, and net seepage into the groundwater basin. Natural recharge to principal drinking water aquifers is about 50,000 AFY on average based on estimates from 2010 to 2019. In 2019, natural recharge was estimated to be 52,000 AF.[87]

The preservation of open space supports agriculture and natural recharge capacity. The District Act limits agricultural groundwater production charges to no more than 25% of non-agricultural charges, and current Board policy further limits it to no more than 10% in order to preserve open space in Santa Clara County. Valley Water uses non-rate revenue (e.g., 1 percent ad valorem property tax revenue) to offset related lost agricultural revenue for each customer class. Valley Water staff reviews land use plans provided by local cities and the county, encouraging the preservation of natural infiltration and reduction of impervious surfaces in the areas that contribute groundwater recharge to the principal aquifers.

6.1.4 Groundwater Production Management

The Santa Clara and Llagas subbasins are not adjudicated and Valley Water has not historically controlled the operation of groundwater wells or the amount of groundwater that wells can produce. The groundwater recharge program, treated water sales, recycled water partnerships and aggressive water conservation programs all offset demand on groundwater resources. Valley Water's tools to influence groundwater production are discussed below.

6.1.4.1 Groundwater Production Measurement

The amount of groundwater pumped from the groundwater subbasins is recorded (Table 6-1) in accordance with the District Act. Within Valley Water's groundwater benefit zones, the owners and operators of water producing

[87] Santa Clara Valley Water District, FY 2020-21 Protection and Augmentation of Water Supplies.

facilities must file production statements with Valley Water on either an annual, semi-annual, or monthly basis depending on the amount of water produced.

Table 6-1. Valley Water Well Metering Summary (FY 2019)

Groundwater Benefit Zone[1]	Number of Metered Wells	Metered Well Production[2] (AF)	Number of Non-Metered Wells	Estimated Non-Metered Well Production[2] (AF)
W-2	644	56,000	426	1,400
W-5	503	42,600	3,198	9,000
Total	**1,147**	**98,600**	**3,624**	**10,400**

Notes:

1. Groundwater benefit zone W-2 largely coincides with the Santa Clara Plain and W-5 coincides with Coyote Valley and Llagas Subbasin. On July 1, 2020, new and modified benefit zones went into effect[88], including W-2 that largely coincides with the Santa Clara Plain, W-7 that largely coincides with the Coyote Valley, and W-5 and W-8 that largely coincide with the Llagas Subbasin. A complete year of data is not yet available for the new and modified zones, but related pumping and metering information will be provided in future annual SGMA reports.
2. Production values are rounded to the nearest 100 AF. Estimated (non-metered) production values are based on statements submitted to Valley Water based on tables of average use that may include acreage, types of water use on the property, and crop type(s).

By Valley Water Board Resolution, meters are only installed at those sites determined by staff to be economically feasible per approved criteria or as required to facilitate the complete and accurate collection of groundwater production revenue. Valley Water currently installs, calibrates, and reads meters on related wells, unless the well owner prefers to undertake this responsibility. In the Santa Clara Plain, meters are required for facilities producing more than 4 AF of agricultural water or more than 1 AF of non-agricultural water annually. Within the Coyote Valley or Llagas Subbasin, meters are required for facilities producing more than 20 AF of agricultural water or more than 2 AF of non-agricultural water.[89] The Valley Water Board has the ability to modify the volumetric thresholds for metering as well as related responsibilities for installation, maintenance, and reading.

Metered wells extract the vast majority of the groundwater used (Table 6-1). As noted, where meters are not used, crop factors are used to determine agricultural water use and average values are used to estimate domestic use. Valley Water will explore whether additional metering may be beneficial to support continued groundwater sustainability.

Valley Water also tracks surface water, treated water and recycled water production within the county, and charges users volumetric rates. Water meter testing and maintenance are performed on a regular basis to ensure meters are performing accurately. When problems are discovered, meters are repaired or replaced. Meters are also replaced on a regular basis for testing and rebuilding.

6.1.4.2 Retailer Coordination on Source Shifts and Shortage Response

An essential component of water supply reliability is the cooperation between Valley Water and its water retailers, particularly in the implementation of programs that offset groundwater pumping such as treated water deliveries and water use efficiency. This cooperation has been critical during times of shortage per the examples below.

[88] Details about the new groundwater benefit zones are available on Valley Water website: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/groundwater-benefit-zone-study

[89] Santa Clara Valley Water District, Board of Directors Resolution 91-53.

In 2014, the Board asked retail water agencies, local municipalities and the County of Santa Clara to implement mandatory measures as needed to achieve a 20 percent water use reduction compared to 2013. In the Santa Clara Plain, increased reliance on groundwater reserves caused water levels to approach or temporarily fall below subsidence thresholds at several index wells. Valley Water worked with several retailers to reduce pumping in key areas, which resulted in improved conditions.

Due to the continued extreme drought, in March 2015 the Board increased the water use reduction target to 30% compared to 2013 use and asked that outdoor watering be limited to no more than two days per week. Nearly all water retailers supported Valley Water's water use reduction target, which was higher than their state-mandated targets in many cases. Coordinated community outreach, such as consistent messaging on outdoor watering, lead to an impressive 27% countywide savings in potable water use compared to 2013. Retailer efforts to use treated surface water and reduce pumping in certain areas were also instrumental in groundwater level recovery and minimizing the risk of resumed land subsidence. Groundwater levels and storage fully recovered to pre-drought levels by 2017.

In June 2021, the Board declared a water shortage emergency conditions in Santa Clara County due to the extreme drought and extended loss of usable storage in Anderson Reservoir due to seismic retrofit. The Board also called for a mandatory 15% reduction in water use compared to 2019. Similar to the previous (2012–2016) drought, Valley Water is collaborating with water retailers as they work to achieve the water use reduction target and communicate with their customers.

6.1.4.3 Groundwater Zones and Groundwater Charges

Valley Water has the authority to establish a zone or zones within which it can levy charges for all groundwater-producing facilities. The purpose of these charges is to fund Valley Water activities that protect and augment the water supplies for users within the zones. Creation or modification of charge zones can allow different levels of service within Valley Water's service area, with water users in each zone paying appropriately for the services received. Per the District Act, groundwater charges can be used to pay for costs associated with the following activities, as well as the principal or interest related to these costs:

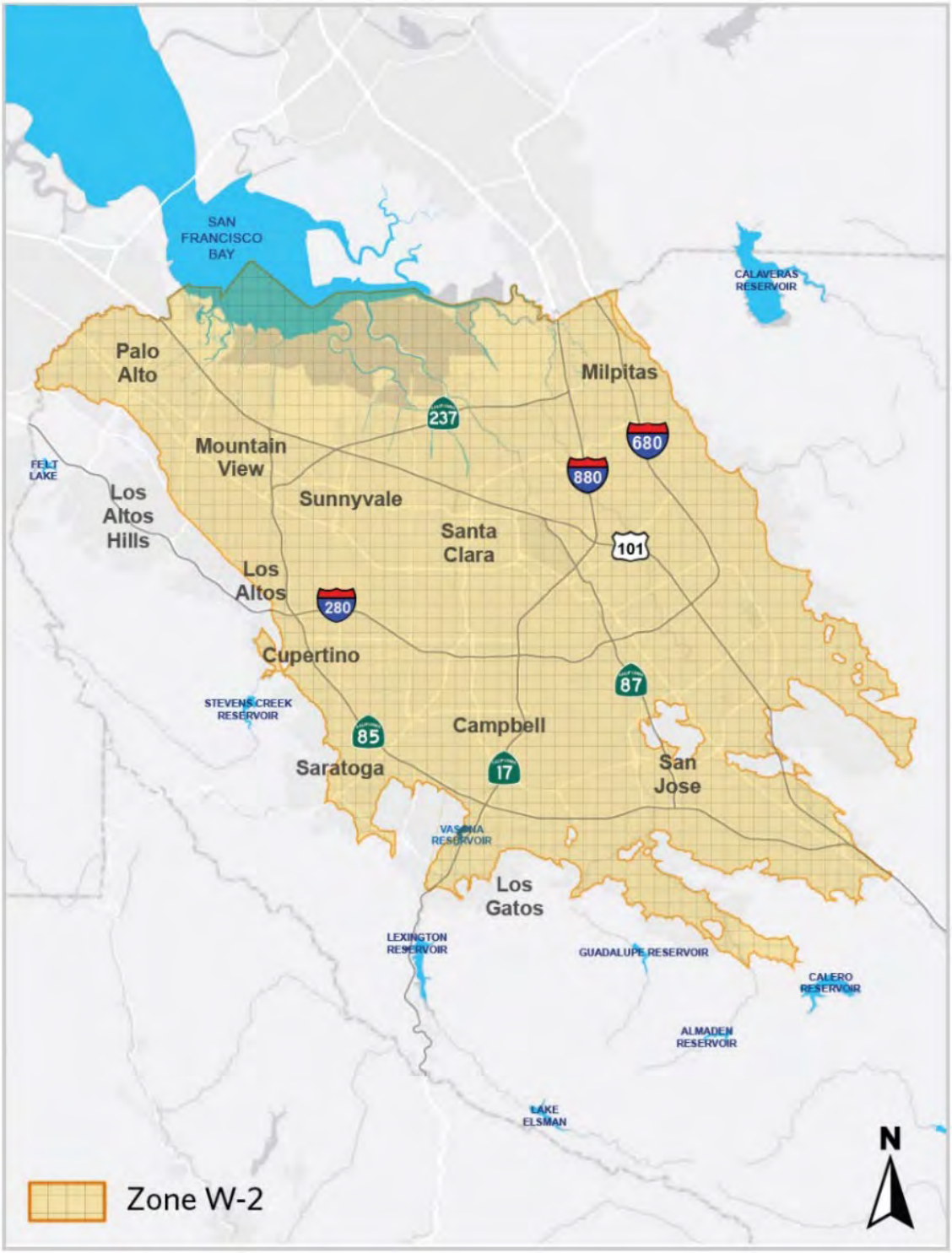
- Constructing, maintaining, and operating facilities to import water,
- Purchasing water for importation, and
- Constructing, maintaining, and operating facilities to conserve or distribute water, including facilities for groundwater recharge, surface distribution, and the purification and treatment of water.

For many decades, Valley Water had two groundwater benefit zones: Zone W-2 (North County, largely coinciding with the Santa Clara Plain (Figure 4-9)) and Zone W-5 (South County, largely coinciding with the Coyote Valley and the Llagas Subbasin (Figures 4-9 and 4-13)). In 2020, Valley Water concluded an extensive groundwater benefit zone study[90] that re-evaluated the zone boundaries and resulted in new and modified zones that became effective in July 2020:

- Modified Zone W-2 (Santa Clara Plain Valley Floor)
- Modified Zone W-5 (Llagas Subbasin Valley Floor)
- New Zone W-7 (Coyote Valley)
- New Zone W-8 (areas below Uvas and Chesbro Reservoirs)

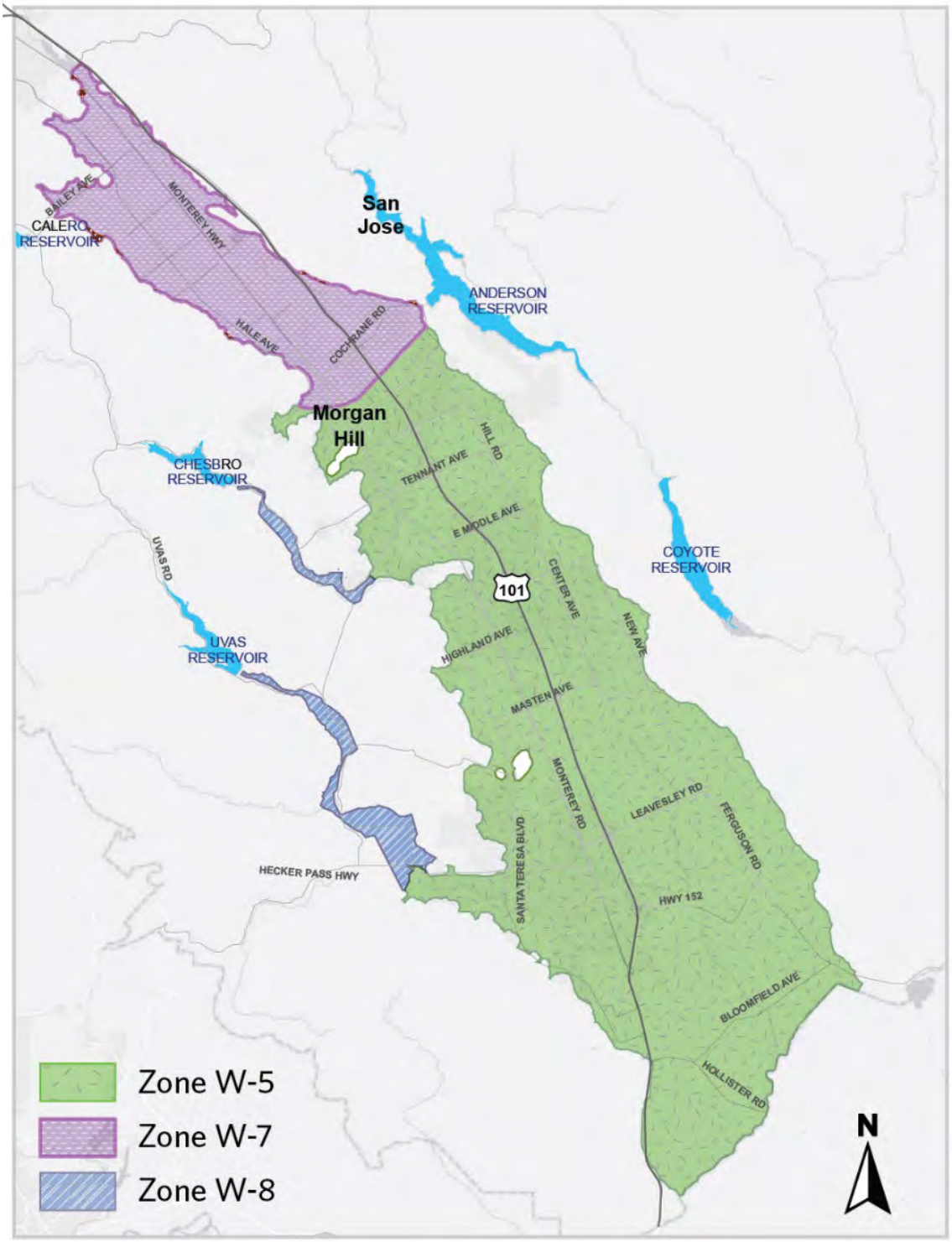
[90] Montgomery & Associates, December 2020, Groundwater Benefit Zone Study Santa Clara County, California, prepared for Santa Clara Valley Water District, 145 pages.

Figure 6-1. Modified Groundwater Benefit Zone W-2



Note – figure modified from Valley Water's FY 2021-22 Protection and Augmentation of Water Supplies (PAWS) Report.

Figure 6-2. Modified Groundwater Benefit Zone W-5 and New Zones W-7 and W-8



Note – figure modified from Valley Water's FY 2021-22 Protection and Augmentation of Water Supplies (PAWS) Report.

6.1.4.4 Pricing Policies

In creating zones and setting water rates, Valley Water utilizes several concepts as presented in Resolution 99-21, including water pooling and water resource management strategies. Under Valley Water's pooling approach, water is considered a single commodity irrespective of the water's source or costs since all users benefit from the availability of multiple sources of water. The costs of the treated water facilities are pooled with all other costs within the zone of benefit and recouped primarily through the basic charge assessed on all groundwater pumped from the Santa Clara and Llagas subbasins and/or provided by Valley Water in treated water deliveries.

For Valley Water's treated water retail customers, who receive treated imported surface water supplies, such customers pay the same AF charge that municipal and industrial groundwater pumpers pay per AF of water extracted as well as an additional treated water surcharge. Most of Valley Water's large retail partners distribute potable water to their customers that comes either from: (a) Valley Water surface water supplies and treatment plants; (b) SFPUC surface-water supplies, and/or (c) local groundwater pumping. San Jose Water Company and Stanford also have local surface-water supplies that are delivered to their customers. The treated water surcharge is set by Valley Water to influence its retailers in their choice between using treated water purchases versus groundwater extraction so that groundwater pumping can be better managed. A higher treated water surcharge encourages more groundwater pumping, and a lower surcharge encourages less groundwater pumping. Also, Valley Water may offer additional treated water to retailers above their contracted delivery amounts in order encourage retailers to take more treated water rather than pump local groundwater. This approach allows the greatest flexibility in water resources management for the overall benefit of all water users in the county, including those that do not receive treated water.

6.1.5 Water Accounting

As described in Section 4.3.1 Valley Water uses local and imported surface water to conduct an active managed recharge program. Many other Valley Water programs are needed to support managed recharge, including those related to dam maintenance, the administration and management of imported water contracts, local water rights management, and maintenance of the raw water conveyance system.

To reconcile all measured imported water, reservoir inflows and releases, and changes in surface water storage, a periodic water balance is performed. The results of this balance become the final accounting for distribution and facility processing. The data is used for water rights reporting, accounting for usage of federal water, for facility performance measurement purposes, and for the groundwater subbasin water budget, which is integral to Valley Water's annual PAWS Report. This report establishes the recommended water rates for the next year based on anticipated costs to meet the projected water need.

6.1.6 Groundwater Level and Storage Assessment

Valley Water staff evaluates current groundwater levels and storage, and projects future groundwater supply conditions under various water supply scenarios. This analysis supports Valley Water's conjunctive management programs, water supply operations, and water supply planning efforts. Specific activities include the use and maintenance of groundwater models as well as groundwater level and subsidence databases.

Valley Water programs that monitor, track, and evaluate rainfall, surface flows, recharge, and reservoir operations allow the preparation of a detailed surface water balance, which provides data for groundwater models, including stream stage and flow data, managed recharge estimates, and rainfall data. Along with groundwater pumping data, these data allow Valley Water to project groundwater elevations and storage under different operations scenarios.

6.1.6.1 Operations Planning to Meet Near-Term Needs

Valley Water conducts ongoing operational planning to meet demands, protect groundwater reserves, and ensure adequate carryover supplies. Each fall, Valley Water initiates the annual operations planning process. Imported and local supplies are estimated, and operations scenarios are developed for the following calendar year, using different hydrologic projections. During the process, imported water deliveries, out-of-county water bank withdrawals or deposits, managed recharge operations, and local water releases to streams and the Bay are projected. Typically, by late spring, there is more certainty with regard to hydrologic conditions, and therefore imported water deliveries, reservoir inflows, and local demands. Other factors that impact Valley Water's water supply include infrastructure and facility limitations; planned and unplanned facilities outages; contractual obligations; the ability to bring in banked Valley Water supplies from Semitropic Water Storage District; and regulatory, institutional, and legal constraints. If it appears that groundwater reserves will be drawn down below operational targets, then managed recharge operations may be increased where needed or treated water deliveries may be encouraged to offset groundwater pumping. During droughts, Valley Water also works with water retailers to set demand reduction targets and increase conservation promotions to help protect the groundwater subbasins from overdraft. As the water year progresses and more information becomes available, the operations plans are revised accordingly to optimize local water supply reliability.

6.1.6.2 Contingency Planning

Valley Water's UWMP[91] details its water shortage contingency planning that recognizes groundwater storage as a critical consideration in water supply reliability. An important component of meaningful shortage response is the ability to recognize a pending shortage before it occurs, early enough so that multiple options remain available and before supplies that may be crucial later have been depleted.

Given the operational priorities of Valley Water, projected end of the year groundwater storage serves as the best single indicator of possible impending water shortages. The Water Shortage Contingency Plan (WSCP) in the UWMP proposes guidelines for shortage response, based on projected groundwater storage (Table 6-2). If the projected end of year total groundwater storage is anticipated to drop below 300,000 AF, then shortage response is called for, such as short-term water demand reduction measures. These short-term water demand reduction measures are in addition to ongoing water conservation programs. Chapter 5 of this GWMP includes a breakdown of the 300,000 AF storage target by groundwater management area.

Table 6-2. Stages of Valley Water's Water Shortage Contingency Plan (WSCP)

Stage	Stage Title	Projected End of Year Combined Groundwater Storage in the Santa Clara and Llagas Subbasins (AF)	Recommended Short-Term Water Use Reduction
1	Normal	Greater than 300,000	None
2	Alert	300,000 to 250,000	0 to 10%
3	Severe	250,000 to 200,000	10 to 20%
4	Critical	200,000 to 150,000	20 to 40%
5	Emergency	Less than 150,000	Greater than 40%

[91] Santa Clara Valley Water District, Urban Water Management Plan, 2020.

6.1.6.3 Planning to Meet Future Needs

Valley Water's UWMP and WSMP evaluate water supply reliability under future scenarios. Every five years, urban water suppliers must prepare an UWMP assessing their water demands, supplies, and potential shortfalls over the next 20 years. The 2020 UWMP show a continued reliance on groundwater in the future.

Valley Water has coordinated with water retailers on planning for future waters supply to meet countywide water demands. Water retailers deliver over 85% of the total water used in the county and nearly 95% of the water used in the Santa Clara Plain in northern Santa Clara County. Valley Water's UWMP evaluates whether the projected groundwater use can be sustained over a 25-year planning horizon without risking depletion of groundwater reserves or failing to meet water supply reliability targets. The UWMP (and WSMP described below) use over 90 years of measured or correlated local hydrologic data and are supported by information in the GWMP. Valley Water's UWMP highlights the importance of groundwater reserves, which are critical to meet demands in dry years. Multiple dry years pose the greatest challenge to Valley Water's water supply as storage reserves typically become depleted.

The purpose of Valley Water's WSMP is to identify and plan the new water supply projects and programs that will be needed to ensure future water supply reliability and groundwater sustainability over a 25-year planning horizon. Preparing the WSMP includes developing objectives based on Board policy; performing a baseline system analysis to determine water supply and infrastructure needs; developing a recommended portfolio of projects and programs to meet those needs; conducting appropriate environmental analysis; engaging water retailers and interested stakeholders in plan development; and preparing a schedule and budget for implementing the recommended portfolio. The WSMP will be updated at least every five years to reflect current conditions. The WSMP 2040 includes an annual Monitoring and Assessment Plan (MAP) that will monitor and report on demands, supplies, and the status of projects and programs in the WSMP so the Board can use that information in its annual strategic planning sessions. The MAP will help the annual water rate-setting process, Capital Improvement Program (CIP), and budget process.

Valley Water staff also coordinates with land use agencies to review certain Environmental Impact Reports, land use proposals, and Water Supply Assessments required for development decisions that meet certain thresholds.[92] Valley Water has been working closely with retailers and cities to address these water supply assessments and other water supply issues. Projections of future groundwater levels and storage are also performed to support other Valley Water planning efforts, including the evaluation of the feasibility of indirect potable reuse and wetland projects.

6.1.7 Asset Management

Maintaining the integrity of Valley Water's existing infrastructure is essential for water supply reliability. This includes maintaining recharge facilities and all Valley Water facilities, such as reservoirs, treatment plants, and conveyance and distribution infrastructure. Valley Water maintains a rigorous asset management program to optimize asset renewal strategies and minimize the total cost of owning assets while providing expected service levels and operating at an acceptable level of risk. The program seeks to reduce unplanned infrastructure failure and service disruptions and improve reliability of water supply infrastructure. The program helps to optimize asset lifecycle costs, enable accurate financial planning to sustainably deliver services, and capture and transfer asset-specific knowledge.

[92] California Water Code Section 10610.

6.2 PROGRAMS TO PROTECT GROUNDWATER QUALITY

This section describes activities by Valley Water and other entities that address groundwater quality protection in Santa Clara County. In addition, Valley Water monitors emerging policy and regulatory trends; collaborates with key decision makers and stakeholders to affect policy change; and works with federal, state, and local government representatives on pending legislation or regulatory standards related to the protection of groundwater quality. The purpose of these activities is to ensure that Valley Water interests are communicated and considered in legislative and regulatory processes.

6.2.1 Well Ordinance Program

The District Act authorizes Valley Water to prevent the contamination, pollution, or otherwise rendering unfit for beneficial use the surface or subsurface water used or useful in the county.[93] As part of its efforts in exercising this authority, Valley Water developed a well ordinance to protect groundwater resources from contamination. The objective of the Well Ordinance Program is to ensure that wells and other deep excavations are properly constructed, maintained, and destroyed so that they will not allow the vertical transport of waters of poor quality into deeper aquifers used for drinking water. Abandoned and unused wells are required to be sealed in accordance with the Well Ordinance.[94] Valley Water is authorized to take civil action to abate a public nuisance caused by wells creating a water contamination hazard.

Each year, Valley Water permits and inspects approximately 1,000 exploratory borings, well destructions, and water supply and monitoring well installations under the Well Ordinance Program.[95] Through this program, Valley Water:

- Develops standards for the proper construction, maintenance, and destruction of wells and other deep excavations,
- Informs the public, including contractors, consultants and other government agencies about the Well Ordinance and the well standards,
- Verifies that wells are properly constructed, maintained, and destroyed using a permitting and inspection mechanism,
- Takes enforcement action against violators of the Well Ordinance, and
- Maintains a database and well mapping system to document information about well permitting, well construction and destruction details, a well's location, and well status.

6.2.2 Domestic Well Testing Program

Although public water supply systems are required to regularly test their wells for compliance with DDW regulations, no such regulation exists for private domestic wells. Elevated nitrate is an ongoing groundwater protection challenge due to historic and ongoing sources including fertilizers, septic systems, and animal waste. To better understand the occurrence of nitrate and to help well owners better understand their water quality, Valley Water has implemented a free domestic well testing program for private well owners within Valley Water's groundwater benefit zones.

In 1998, Valley Water sampled over 600 private wells to obtain data on nitrate contamination and found that over half of the wells tested provided water that exceeded the DDW Maximum Contaminant Level of 10 milligrams per

[93] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60, Section 5(5).
[94] Santa Clara Valley Water District Ordinance 90-1.
[95] Santa Clara Valley Water District, FY 2021-2025 Water Utility Enterprise Operations & Maintenance Plan.

liter[96] of nitrate as nitrogen. In 2011, Valley Water started the free domestic well testing program in the southern part of the county, which was subsequently expanded to the northern part of the county in 2012 and continues to be offered annually. Over 1,900 private well tests have been conducted by Valley Water under this program, which also includes other basic water quality parameters like total dissolved solids (TDS), hardness, and bacteria. The program benefits Valley Water by providing more localized information on nitrate and other parameters to supplement regional groundwater monitoring data.

6.2.3 Recycled Water Irrigation Evaluation

Recycled water generally has a higher concentration of salts, nutrients, disinfection byproducts, and emerging contaminants than groundwater or treated water, and these contaminants may be introduced to groundwater through landscape irrigation. Recycled water is currently used only for non-potable uses like landscape irrigation, agriculture, and industry. Recycled water undergoes tertiary treatment, except for the South Bay Water Recycling (SBWR) system as described below. With the exception of the Evergreen and Edenvale areas of San Jose and portions of the Llagas Subbasin in Gilroy, all current use of recycled water is limited to the confined areas, where significant clays and silts offer a measure of natural protection to deeper drinking water aquifers.

Several groundwater monitoring efforts and studies provide data to help assess potential changes to groundwater quality resulting from the irrigation of recycled water. Valley Water evaluates groundwater monitoring data collected by SBWR, which indicates increasing trends for several inorganic parameters, including chloride and boron, following recycled water application.[97]

In August 2011, Valley Water completed the Recycled Water Irrigation and Groundwater Study[98] to evaluate the potential effects of recycled water used for irrigation on groundwater quality in the Santa Clara Plain and Llagas Subbasin and to identify best management practices to protect groundwater. The study included laboratory testing of soils irrigated with recycled water and an 18-month field study at a site using recycled water for irrigation in the Santa Clara Plain. The study found no significant change in groundwater quality for most parameters monitored. However, some changes were noted, including the presence of a few parameters not previously found in shallow groundwater at the site. A common by-product of the water disinfection process, N-Nitrosodimethylamine (NDMA), was detected in groundwater 30 feet below the surface at trace levels of 3 to 4 parts per trillion (ppt) during the study. Subsequent sampling has found levels of NDMA up to 18 ppt (a one-time detection). Low-level detections of per- and polyfluoroalkyl substances (PFAS) as well as other emerging contaminants have been observed in shallow groundwater near other recycled water irrigation sites in the county. The study findings suggest that best management practices and/or changes in recycled water treatment may be warranted when irrigating with recycled water over sensitive parts of the Santa Clara Plain or Llagas Subbasin.

In 2014, Valley Water completed construction of the Silicon Valley Advanced Water Purification Center (SVAWPC). The advanced treated water from the SVAWPC is blended with tertiary treated water from the San Jose-Santa Clara Regional Wastewater Facility (SJSCRWF) to lower TDS and distributed to SBWR recycled water customers. Valley Water continues to monitor groundwater for recycled water impacts and is evaluating whether improvements to shallow groundwater are observed because of blending operations.

As the shallow and unconfined Coyote Valley is highly vulnerable to contamination, Valley Water has determined that all recycled water used for irrigation in that area must be fully advanced treated to avoid groundwater quality impacts**.** This determination was made during Valley Water review of the Coyote Valley Specific Plan, a large

[96] Santa Clara Valley Water District, Private Well Water Testing Nitrate Data Report, 1998.

[97] Santa Clara Valley Water District, City of San José South Bay Water Recycling Groundwater Data Evaluation, May 2008.

[98] Locus Technologies for Santa Clara Valley Water District, Recycled Water Irrigation and Groundwater Study, Santa Clara and Llagas Groundwater Subbasins, Santa Clara County, California, August 2011.

proposed development in the Coyote Valley that has since been postponed indefinitely.

6.2.4 Vulnerability Assessment

Numerous groundwater vulnerability assessments for groundwater and wells have been conducted in the Santa Clara and Llagas subbasins as described below.

6.2.4.1 Groundwater Vulnerability Studies

In 1985, the San Francisco Bay Water Board completed a vulnerability study,[99] which rated 105 hazardous materials release sites in terms of groundwater pollution potential based on the distance to wells and depth to water as well as the severity of the contamination. The study focused on existing contamination sites and did not consider potentially contaminating activities.

In 1999, Valley Water completed an evaluation of the sensitivity of the groundwater subbasins based on its intrinsic or hydrogeologic characteristics using the USEPA DRASTIC methodology.[100] The DRASTIC evaluation resulted in a GIS coverage that presents the relative sensitivity of different parts of the subbasins to contamination.[101]

In 2007, Valley Water completed a study partially funded by the San Francisco Bay Water Board on the potential for groundwater contamination from past dry cleaner operations. Valley Water ranked hundreds of operating and former dry-cleaning operations for their potential to contaminate water supply wells based on the age and duration of dry-cleaning operations, hydrogeologic factors, and municipal well construction. The study found that despite the high number of dry-cleaning operations in the county, the impact on deep drinking water aquifers has been very limited.[102]

In October 2010, Valley Water completed a comprehensive groundwater vulnerability study to assess the vulnerability of groundwater subbasins to land use activities.[103] This study updated the previous sensitivity study, incorporating recent hydrogeologic data and a statistical (rather than subjective) weighting approach. It also evaluated the vulnerability of the subbasins to different land uses. The study findings and related GIS tool have been used to help prioritize Valley Water work (including the review of high-threat contamination sites) and optimize the groundwater quality monitoring network. Valley Water also met with several land use and regulatory agencies to discuss the potential use of the GIS tool to assist in their groundwater protection efforts.

6.2.4.2 Drinking Water Source Assessment and Protection Program (DWSAP)

The goals of the State's DWSAP required under the 1996 reauthorization of the federal Safe Drinking Water Act are as follows:

- Protect public water systems,
- Improve drinking water quality and support effective water resources management,

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[99] San Francisco Bay Water Board, Sanitary Engineering and Environmental Health Research Laboratory, University of Berkeley, and Santa Clara Valley Water District, Assessment of Contamination from Leaks of Hazardous Materials in Santa Clara Groundwater Basin, 205j Report, June 1985.
[100] USEPA, DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings, 1987.
[101] Santa Clara Valley Water District, An Analysis of the Sensitivity to Contamination of the Santa Clara Valley Groundwater Aquifers Based on the USEPA DRASTIC Methodology, 1999.
[102] Santa Clara Valley Water District, Study of Potential for Groundwater Contamination from Past Dry Cleaner Operations in Santa Clara County, 2007
[103] Todd Engineers and Kennedy/Jenks Consultants for the Santa Clara Valley Water District, Revised Final Groundwater Vulnerability Study, Santa Clara County, California, October 2010.

- Inform public and drinking water systems of contaminants and potential contaminating activities that have the potential to affect drinking water,
- Promote a proactive approach to protecting drinking water quality and enable communities and drinking water systems to protect water quality,
- Refine and focus drinking water source monitoring requirements, and
- Focus pollution prevention and cleanup on areas that are subject to more serious threats.

Valley Water assisted many of the local water retailers in their initial compliance with the State's DWSAP requirements in 2002 and 2003. The assessments included delineating well protection areas, inventorying possible contaminating activities, and analyzing the vulnerability of the source. Valley Water developed a GIS-based application, which was used to delineate protection areas in accordance with state guidelines. In addition, Valley Water shared the application with the DWSAP data advisory committee, on which Valley Water was an active participant during development of the DWSAP implementation guidelines. Local water retailers are responsible for completing the DWSAP for all newly installed wells, and Valley Water provides assistance upon request.

6.2.5 Coordination with Land Use Agencies

As land uses intensify, so does the potential for contaminating the underlying groundwater. In highly urbanized areas such as the Bay Area, there are numerous threats to groundwater resulting from commercial, industrial, and residential development. These threats include urban runoff, industrial chemical spills, leaking underground storage tanks, and residential and agricultural use of nitrogen-based fertilizers and pesticides. Coordination with land use agencies helps ensure groundwater quality is protected.

6.2.5.1 Land Use Review

Most land use decisions fall under the authority of local cities and the county. These agencies, Valley Water, and the water retailers all desire to maintain high-quality water resources to serve current and future uses. These agencies work together to ensure that groundwater is adequately protected from potentially contaminating activities. Of particular concern are potentially contaminating activities over groundwater recharge areas, which are more vulnerable to contamination due to the presence of high permeability soils and higher groundwater flow rates.

Valley Water reviews some local land use and development plans to identify threats to groundwater and watercourses that are under Valley Water jurisdiction. Valley Water also provides review and comment on various environmental documents, and city and County General Plans. Valley Water has worked with land use agencies to develop guidelines or model ordinances for specific issues such as the permitting of graywater systems. Valley Water works with project and regulatory stakeholders so that these projects are implemented in a manner that protects groundwater resources.

6.2.5.2 Onsite Wastewater Treatment Systems (Septic Systems)

The installation of Onsite Wastewater Treatment Systems (OWTS, or septic systems) is generally overseen by the County DEH under the Local Agency Management Plan (LAMP) as delegated by the Water Board. Permits are only issued in those areas of the county where a sanitary sewer is not available within 300 feet of the property line. An OWTS cannot be used if soil conditions, topography, high groundwater table, or other factors indicate that this method of sewage disposal is unsuitable. The County DEH, in consultation with Valley Water and other stakeholders, developed a wastewater disposal system ordinance that describes the requirements for development, site evaluation, septic system siting, installation, maintenance, and reporting.[104] Various permits are required to

[104] County of Santa Clara Ordinance No. NS-517.85, Onsite Wastewater Treatment Systems, September 2013.

install a septic system and the systems are inspected prior to approving completion of the installation.

6.2.6 Coordination with Regulatory Agencies

Sites with releases of solvents, toxics, fuels, or other contaminants pose a threat to groundwater quality. If allowed to migrate, such contamination may eventually impact water supply wells, forcing well operators to cease operation, implement expensive wellhead treatment, or blend the affected water with other sources of water to dilute the contaminant. In addition, the degradation in water quality can limit the beneficial uses and alter plans for production well siting or design.

6.2.6.1 Hazardous Material Handling and Storage Oversight

The primary causes of groundwater contamination at hazardous material release sites are the improper handling of hazardous materials or leaking storage tanks. Permitting and inspection related to the handling and storage of hazardous materials is overseen by the local or county fire department. The fire departments also oversee the installation, operation, and removal of all underground and above ground storage tanks and associated piping and notify the County DEH and/or Water Boards if contamination is discovered.

6.2.6.2 Contaminant Release Sites

According to GeoTracker[105], the State Water Resources Control Board's online data management tool, there are more than 3,350 sites with environmental releases within the Santa Clara and Llagas subbasins, as summarized in Table 6-3. Most of these releases (over 2,500) are leaking underground storage tank (LUST) sites. Fuel leak cases are overseen by the County DEH while the oversight agencies for the non-fuel leak sites vary, as shown in Table 6-4.

Table 6-3. Status of Contaminant Release Sites[106]

Case Status	Santa Clara Subbasin		Llagas Subbasin	
	Cleanup Program Site	LUST Cleanup Site	Cleanup Program Site	LUST Cleanup Site
Site Assessment	96	18	2	1
Assessment and Interim Remediation	36	8	3	
Remediation	86	8	2	
Verification Monitoring	64	16	1	2
Eligible for Closure	10	9		
Inactive	79			
Open	371	59	8	3
Closed	411	2,343	12	152
Total	782	2,402	20	155

[105] https://geotracker.waterboards.ca.gov/
[106] Site information accurate as of November 2020

Table 6-4. Oversight of Contaminant Release Sites

	Santa Clara Subbasin	Llagas Subbasin
County DEH	2,436	132
San Francisco Bay Water Board (Region 2)	726	
Central Coast Water Board (Region 3)		26
City of Gilroy		15
US Environmental Protection Agency	7	
Department of Toxic Substances Control	2	1
State Water Resources Control Board	2	

Open and closed contaminant release sites in the Santa Clara and Llagas subbasins are shown in Figures 6-3 and 6-4, respectively. These figures include data available through the State Water Board's GeoTracker system, and do not represent all contaminant release sites in the county. As the county's groundwater management agency, Valley Water works with these agencies to protect groundwater resources. Current Valley Water interaction with regulatory agencies on point-source cases is mainly focused on the highest threat cases in the county or is in response to specific requests from the agencies.

Figure 6-3. Contaminant Release Sites in the Santa Clara Subbasin

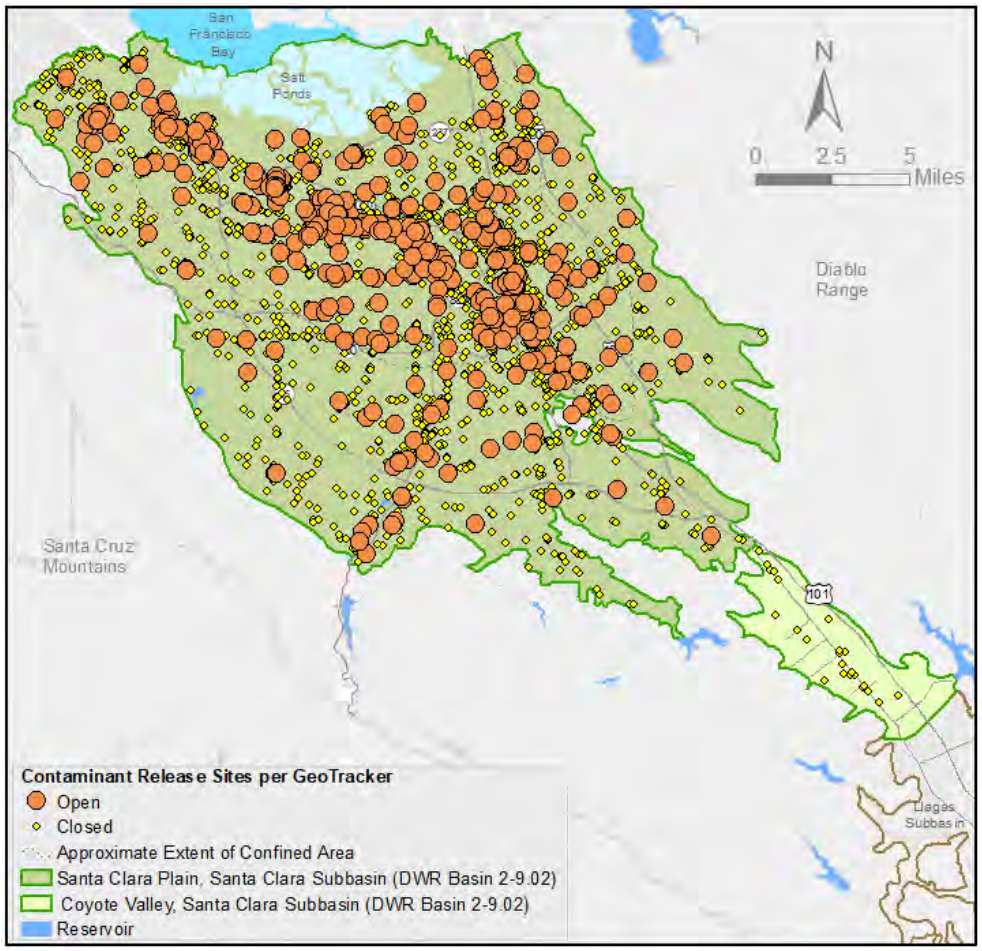
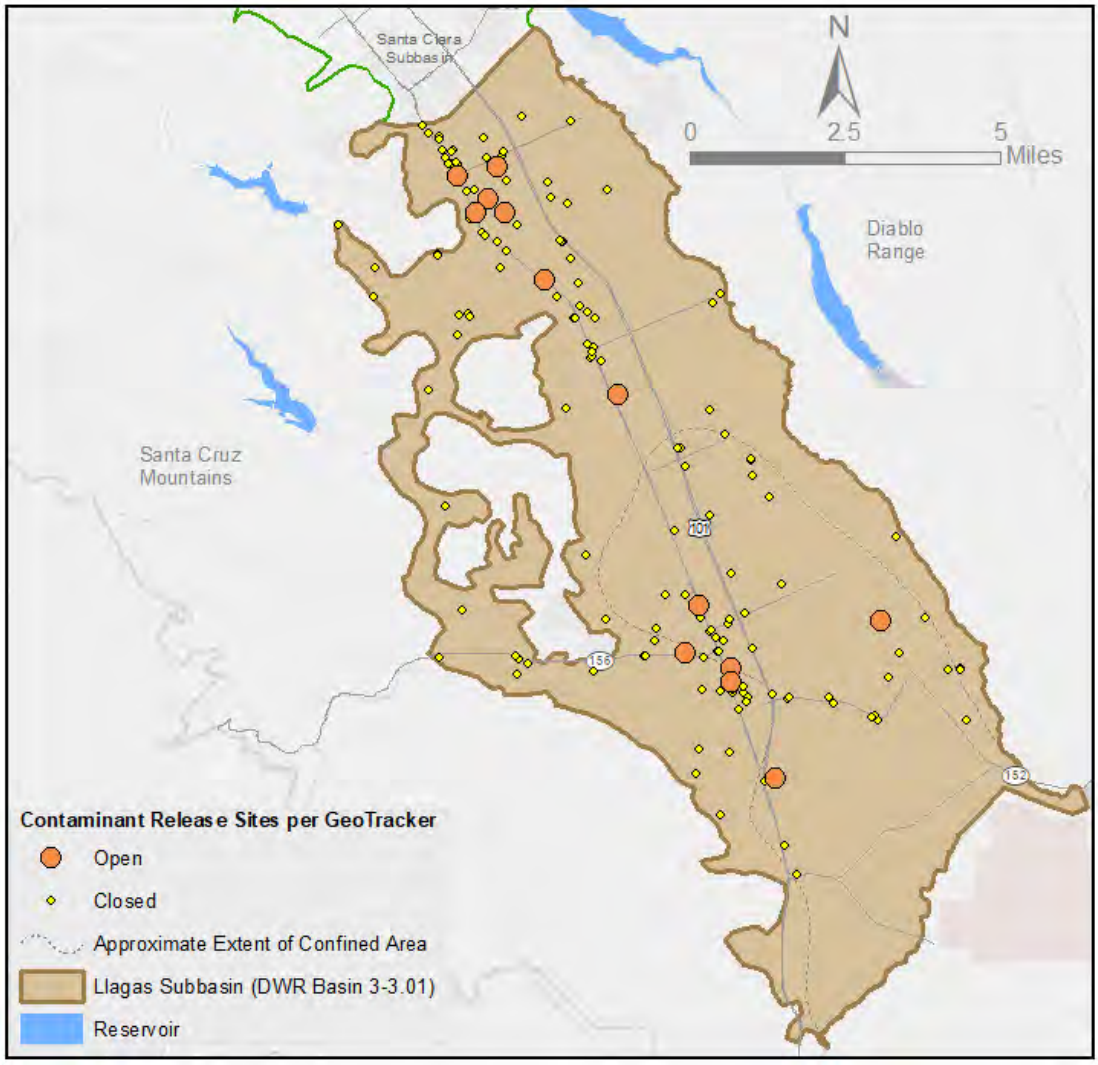


Figure 6-4. Contaminant Release Sites in the Llagas Subbasin



6.2.7 Public Outreach

Public outreach is an important component of Valley Water's groundwater protection efforts. Because groundwater is far removed from the public's view, it can be a challenge to make the connection that actions occurring on the land surface can impact groundwater quality. To increase public awareness of groundwater resources, Valley Water conducts active public outreach programs, which are described in this section. Also, each year, Valley Water celebrates Groundwater Awareness Week, which is an annual observation of the importance of groundwater and is celebrated by the National Groundwater Association, the U.S. Environmental Protection Agency, and other organizations advocating for groundwater protection.

6.2.7.1 Outreach Materials

The preparation of pamphlets, fact sheets, and summary reports helps to transmit key messages related to groundwater. Valley Water's Guide for the Private Well Owner, which is provided to all new well owners in the

county, describes the basics of proper well construction, maintenance, and testing. Valley Water also produces fact sheets to address specific issues, such as nitrate or PFAS.

6.2.7.2 School Program

Valley Water believes it is never too early for children to begin understanding and appreciating their local water resources. To help promote that awareness, Valley Water offers a full range of educational programs for both teachers and students. From puppet plays for kindergarteners to workshops for educators, school outreach projects provide effective, hands-on learning experiences that meet new state standards. Through Valley Water's educational programs, students can tour a groundwater recharge facility, create a simulated pond or explore the plant and animal life in a creek. All activities are geared for specific grade levels, from pre-kindergarten to college.

6.2.7.3 Groundwater Guardian Program

The Groundwater Guardian Program is sponsored by the Groundwater Foundation, a not-for-profit education organization that strives to increase groundwater awareness. Groundwater Guardian is an annually earned designation for communities and affiliates that take voluntary, proactive steps toward groundwater protection. Valley Water has been designated a Groundwater Guardian based on such activities as conducting irrigation and nutrient management seminars, creating a prototype zone of contribution delineation tool for wellhead protection areas, and conducting the school program since 2000. Valley Water will continue to participate in the program by submitting annual work plans for groundwater protection activities and submitting reports documenting our groundwater protection efforts.

6.3 PROGRAMS RELATED TO SURFACE WATER/GROUNDWATER INTERACTION

Valley Water has been conducting managed recharge of the Santa Clara and Llagas subbasins with locally captured and imported water for many decades. Valley Water's managed recharge program is an important management tool that has contributed to groundwater storage recovery, cessation of inelastic land subsidence, prevention of seawater intrusion, and improved water quality. A reliable water supply for the county depends on this interaction between surface water and groundwater, and as such, Valley Water closely monitors recharge operations.

The addition of water through managed or incidental recharge can change groundwater quality. This may be for the better by diluting existing contaminants in the aquifer, or for the worse by introducing contaminants. Incidental recharge includes water applied to landscape and agriculture in excess of plant uptake (irrigation return flows), as well as infiltration from stormwater and septic systems. Valley Water programs related to surface water/groundwater interaction are described below.

6.3.1 In-Stream Releases of Surface Water

As described in Section 6.1.1, Valley Water conducts active in-stream managed recharge operations along approximately 91 miles of stream channel in over 30 creeks. About two-thirds of Valley Water's managed recharge occurs through in-stream recharge facilities, with over 60,000 AF recharged in most years as a result of Valley Water releases into creeks. In 2019, in-stream managed recharge was about 66,500 AF. Valley Water also coordinates operations for flashboard dams and spreader dams under agreements with the CDFW. Valley Water recharge operations along streams have been modified in recent years to reflect environmental regulations and concerns, including the protection of native fisheries.

6.3.2 Stormwater Management

To reduce the amount of runoff to creeks and other surface water bodies, urban runoff programs are increasingly promoting the infiltration of stormwater into groundwater instead of facilitating its runoff into creeks. Infiltration of runoff helps reduce peak flows and protect surface water quality. Stormwater can also be a beneficial source of

groundwater recharge in some areas, but there are potential groundwater quality impacts. Stormwater can pick up pollutants as it runs over the ground surface, which can then migrate to groundwater via soil infiltration.

Valley Water is part of the Santa Clara Valley Urban Runoff Management Program, which was formed in 1990 to develop and implement efficient and uniform approaches to control non-point source pollution in stormwater runoff that flows to the South San Francisco Bay and to comply with the Bay Area Municipal Regional Stormwater NPDES Permit. Valley Water has worked with the other co-permittees of the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) to develop guidelines that allow stormwater infiltration while being adequately protective of both surface water and groundwater resources.[107]

There are three main types of controls that promote infiltration. They are site design measures, indirect infiltration methods, and direct infiltration methods. Site design measures involve laying out a development site to reduce the amount of impervious area and routing drainage to landscaped areas. Indirect infiltration methods include directing runoff to bioretention areas, vegetated buffer strips, and to unlined detention ponds. These methods rely on the shallow soil to "filter" the water before it reaches groundwater.

The third method, direct infiltration, sometimes referred to as stormwater infiltration devices (SWIDs), uses devices that bypass the surface soils, thereby bypassing the filtration potential of the surface soils. Types of direct infiltration devices include dry wells, injection wells, and french dry wells, all types of SWIDs that reduce or eliminate the vertical separation between the infiltration point and groundwater. Because they bypass natural filtering capacity of soils, dry wells are of special concern. Specific standards for direct infiltration devices are being developed by the State of California.[108] The purpose of revising the policy is to unify permitting and construction standards so that all devices that bypass natural protection processes are subject to standards for protecting groundwater and to simplify the process by which SWIDs are permitted.

6.3.3 Seawater Intrusion Prevention

Seawater intrusion is the movement of seawater or saline water into a freshwater aquifer. The potential for seawater intrusion exists in groundwater basins adjacent to the ocean or other bodies of saline water – in the case of the Santa Clara Subbasin, the southern portion of San Francisco Bay. Once freshwater aquifers have severe seawater intrusion, it is extremely difficult and costly to reclaim them. Classic seawater intrusion (Appendix H) can occur in coastal aquifers and is often caused by overpumping of groundwater that reverses the normal seaward flow of groundwater. Locally, however, the classic seawater intrusion mechanism has a relatively minor influence on the Santa Clara Subbasin because the aquifers underlying the Bay do not outcrop offshore and are not directly connected to the Bay. Rather, the aquifers are protected by a very fine-grained fully saturated clay formation known as Bay Mud, which effectively seals the aquifers from classic seawater intrusion regardless of the direction of groundwater flow. Appendix H details the relative influence of classic seawater intrusion and other mechanisms in

[107] Guidelines specific to the Bay Area Municipal Regional Stormwater NPDES Permit are published in the "C.3 Stormwater Handbook": https://scvurppp.org/2016/06/20/c-3-stormwater-handbook-june-2016/. Infiltration guidelines specific to groundwater are found in Appendix A of the "C.3 Stormwater Handbook".

[108] The State Water Board recently finalized a report (prepared by Geosyntec Consultants for the State Water Board), "California Dry Well Guidance Research and Recommendations" in March 2020, which includes design considerations that will likely be incorporated into the State Dry Well Standards. These standards are being developed by the Department of Water Resources (DWR) as part of the update to Bulletin 74 (California Well Standards); this Bulletin will include updated standards for well construction and destruction, including drywells.

the Santa Clara Subbasin.

The northern portion of the Santa Clara Plain has a relatively greater influence from the leakance of saltwater beneath tidal stream flow (Appendix H). This mechanism primarily affects the shallow aquifer zone and has created a wide mixed transition zone between fresh and saline groundwater. In the decades following World War II, there was long-term groundwater overdraft that caused high rates of land subsidence and observed seawater intrusion (>100 mg/L chloride) in the shallow aquifer zone. By the 1960s, the area within the 100 mg/L chloride isocontour encompassed a substantial area bounded on the south, west, and east by Highway 101 and Interstate 880 (Figure 5-2). Flattened stream gradients caused by land subsidence resulted in increased inland migration of saline bay water through tidal creeks. This saline water was subsequently transported to the shallow groundwater through streambed percolation and the presence of abandoned wells and other deep excavations.

Historically, Valley Water conducted an extensive program of locating and properly destroying old and abandoned wells in the northern Santa Clara Subbasin along the Bay so that these wells would not act as conduits for seawater intrusion from the shallow groundwater down to the principal aquifer. Ordinance 85-1 gave Valley Water authority to require owners of wells determined to be "public nuisances" to seal and destroy the wells or upgrade them to active or standby status. A more comprehensive well sealing program was in place from 1984 to 2005 that provided financial assistance to properly destroy abandoned wells near areas of known contamination to prevent the contamination of drinking water supplies. Although this assistance program was effective and has now ended, abandoned or unused wells are still required to be sealed in accordance with Valley Water and State well standards.

The resumption of land subsidence and sea level rise are perhaps the greatest potential threat to exacerbate seawater intrusion. Land subsidence would further depress the land surface adjacent to the Bay. Both land subsidence and sea level rise could increase the inland tidal incursion of Bay water along creeks and thus increase the potential area of the shallow aquifer zone to seawater intrusion. Additionally, a lowering of the hydraulic head in the principal aquifer zone may increase the potential for seawater intrusion if there were downward leakage or by-pass flow through the Bay Mud. Valley Water's managed recharge program is critical to maintaining adequate artesian pressure in the principal aquifer zone adjacent and underlying the southern portions of the Bay, which helps protect this important groundwater supply from seawater intrusion. As described in Chapter 7, land subsidence, groundwater elevations, and groundwater quality are actively monitored to minimize risks related to seawater intrusion.

6.3.4 Watershed Management

Valley Water captures large volumes of upper watershed runoff in local reservoirs and manages flows in creeks. Because groundwater sustainability depends on the recharge of local watershed water, the protection of these source waters is essential. The protection of the watersheds' water quality is also vital to assuring a healthy environment for their inhabitants. Valley Water seeks to balance watershed uses, such as the rights of private property owners and public recreational activities, with the protection and management of natural resources. Valley Water recognizes that preserving beneficial watershed uses can benefit reservoir water quality, which in turn benefits the quality of the water delivered to Valley Water treatment plants and recharged into the groundwater subbasins.

Valley Water works to protect the water quality and water supply reliability of Valley Water's reservoirs through regular monitoring, coordination with other agencies on water quality issues, and through activities to protect local reservoirs from potentially contaminating activities. Valley Water also implements projects to address pollutants affecting freshwater, such as mercury contamination.

Valley Water has also developed guidelines and standards for land use near streams. These guidelines were developed in cooperation with local cities, the county, local businesses, agriculture, streamside property owners,

and environmental groups through the Water Resources Protection Collaborative.

Valley Water's One Water Plan[109] integrates the water supply, flood protection, and stream stewardship missions of Valley Water at the watershed scale. Drawing from detailed existing programs and plans, One Water seeks to find the nexus between these three mission components for new opportunities in integrated water resources management. One Water does not replace the substantial existing planning in place by Valley Water's Water Utility Enterprise and the Watersheds Division but instead looks for opportunities to further protect and enhance water resources. The One Water Plan is a long-term endeavor that seeks to build up to long-term improvements in water resources management and watershed conditions. One Water will operate under the current commitments, regulations, and existing restrictions and challenges that drive Valley Water operations and day-to-day work.

6.4 OTHER PROJECTS AND ACTIVITIES TO SUPPORT CONTINUED SUSTAINABILITY

As described above, Valley Water has many programs and activities that protect groundwater supplies and quality. These programs were developed to maintain a reliable water supply, prevent inelastic (permanent) subsidence, and protect groundwater quality, both now and in the future. The related monitoring programs are described in Chapter 7.

This section summarizes specific operations projects and related management activities to help support the continued sustainability of groundwater supplies and quality. The following list includes both existing and new projects and activities recommended in this 2021 GWMP.

Monitoring Network Improvements

Appendix J summarizes Valley Water's recent (2021) analysis of gaps and redundancies in the existing groundwater monitoring networks to ensure these networks provide information that supports a comprehensive understanding of groundwater conditions and informed management decisions. Addressing the recommendations from this gap analysis through the installation of additional monitoring wells is important to support Valley Water's basin management strategies to meet the sustainability goals.

Managed Recharge System Capacity

Valley Water recently (2021) assessed the managed recharge system, including threats to the system, reliability of managed recharge, potential actions, and projects to reduce potential risks, and made recommendations for the development of new data and modeling to address future uncertainties. The estimated capacity of each recharge facility listed in Appendix I is based on available data compiled in 2010. During the wet years (2016–2017) that followed the last drought, many of the recharge ponds that had been cleaned produced greater recharge than the estimated capacity. Studies to update and refine the recharge capacity, including the effects of cleaning and underlying groundwater levels, are recommended for water supply planning and operational decisions. An updated understanding of capacity, infiltration rates, effects of clogging, and how recharge varies seasonally can be used to help improve operations and optimize the managed recharge system.

Stormwater Projects

Valley Water's managed recharge program includes capturing local runoff in reservoirs and releasing it to groundwater recharge facilities or drinking water treatment plants. On average, about 50,000 AFY of local runoff is recharged through existing recharge facilities (2019 Annual Groundwater Report). Through its water supply master planning, Valley Water plans to increase stormwater capture and reuse capacity as part of its 'ensure sustainability

[109] https://onewaterplan.wordpress.com/about-2/

strategy'. Valley Water's stormwater projects for the next 20 years are summarized below.

Green Stormwater Infrastructure (GSI). As part of its conservation program, Valley Water initiated a rebate program to incentivize the installation of rain barrels and cisterns, and the construction of rain gardens in residential and commercial landscapes.

Flood-Managed Aquifer Recharge (Flood-MAR). Valley Water is currently working with UC Water researchers to complete phase one of a feasibility study for capturing and recharging stormwater on open space in Santa Clara County, a process referred to as Flood-MAR. Phase one will determine if and where there may be potential areas suitable for Flood-MAR in Santa Clara County, identify technical approaches and related institutional requirements (e.g., permits, water rights, etc.) for installing Flood-MAR projects on lands identified as suitable, and determine potential program incentives. The first phase of the feasibility study is scheduled for completion in 2022. Depending on the results of this study, Valley Water may pursue further Flood-MAR analysis and/or pilot or permanent Flood-MAR project implementation.

Centralized Stormwater Capture Projects. Centralized stormwater capture projects capture stormwater from multiple parcels for recharge in a single location and/or are municipal projects, including "green streets" projects. The Santa Clara Basin Storm Water Resources Plan completed in December 2018 identified potential projects throughout northern Santa Clara County. These projects would likely be partnerships with other jurisdictions and require outside funding. Valley Water will continue to track project opportunities through its participation in the Santa Clara Valley Urban Runoff Pollution Prevention Program. In addition, Valley Water's WSMP includes the Upper Penitencia Creek flood protection project, which could include stormwater retention components.

Capital Improvement Projects

Major projects in Valley Water's Fiscal Year 2022–2026 Capital Improvement Project (CIP)[110] will improve, repair, replace, or construct infrastructure that supports continued groundwater sustainability. With a significant portion of Valley Water's water supply infrastructure approaching fifty to sixty years of age, maintaining and upgrading the existing infrastructure to ensure each facility functions as intended for its useful life has become the focus of the Water Supply CIP in recent years. The CIP includes 31 Water Supply projects at a cost of $5.4 billion.

Major water supply capital improvements identified in the CIP include:

Storage:
- Almaden Dam Improvements
- Anderson Dam Seismic Retrofit
- Calero Dam Seismic Retrofit
- Guadalupe Dam Seismic Retrofit
- Pacheco Reservoir Expansion

Transmission:
- 10-Year Pipeline Rehabilitation
- Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Implementation
- Vasona Pumping Station Upgrade
- Almaden Valley Pipeline Replacement

Treatment:
- Penitencia Water Treatment Plant Residuals Management
- Rinconada Water Treatment Plant Reliability Improvement

[110] Valley Water's Fiscal Year 2022-2026 Capital Improvement Plan is available at https://www.valleywater.org/how-we-operate/five-year-capital-improvement-program

- Santa Teresa Water Treatment Plant Filter Media Replacement
- Water Treatment Plant Electrical Improvement

Recycled Water:

- Expedited Purified Water Program (Indirect Potable Reuse)
- South County Recycled Water Pipeline

Detailed information on each of these water supply capital projects, including related description, costs, and schedule, is available in the CIP.

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CHAPTER 7 – GROUNDWATER MONITORING AND MODELING

Valley Water conducts a wide range of activities to maintain a reliable water supply, protect groundwater quality, and avoid further land subsidence. Assessing how well these activities are meeting the sustainability goals and specific outcome measure for each subbasin requires effective monitoring. This chapter describes Valley Water programs to monitor groundwater levels, land subsidence, groundwater quality, and surface water, and provides information on the availability of related data. This section also describes Valley Water modeling efforts.

Valley Water's network of water level and water quality monitoring wells is the product of an adaptive and opportunistic regional data collection effort that has evolved over many decades. The network includes new wells installed by Valley Water, existing wells Valley Water has obtained from others, and privately owned wells that Valley Water has obtained monitoring access. Consequently, the network design is different than a network designed specifically for monitoring a contaminated site, for example. While Valley Water's network covers the Santa Clara and Llagas subbasins, the wells are not evenly distributed due to the constraints of the existing built environment and the way many of the wells were obtained. Valley Water supplements data collected through this network with data collected by water retailers as further described below.

For all monitoring, Valley Water works to ensure that the monitored locations and the data collected provide adequate information to understand groundwater conditions to support informed decision-making. This includes assessments of data gaps and redundancies, monitoring protocols, and data management, evaluation, and reporting. Even when the wells or locations monitored change due to issues with well condition or access, the overall network provides strong and comprehensive data to assess conditions within the Santa Clara and Llagas subbasins. As the monitoring networks may need to be expanded or modified and access to wells can vary, the monitoring programs described below may change over time. In conjunction with this five-year GWMP update, Valley Water conducted a comprehensive review of the wells used in each monitoring program to identify gaps and redundancies and help improve effectiveness and efficiency of the monitoring programs; recommendations from the review are summarized below. All changes to the monitoring programs will be documented in each subsequent five-year GWMP update.

7.1 GROUNDWATER LEVEL MONITORING

This section describes the methodology, data collection, data analysis, and reporting for Valley Water's groundwater level monitoring, which includes Valley Water wells and privately-owned wells. Also, Valley Water's collected data is supplemented with data provided by water retailers.

7.1.1 Groundwater Monitoring Network and Measurement Frequency

Valley Water measures water levels and receives additional water level data from water retailer wells on a regular basis from a network of several hundred wells. Monitoring locations and frequencies have evolved over time to support groundwater supply assessment and forecasting, recharge operations, efforts to monitor concentrated pumping and land subsidence, and other purposes. In some locations, Valley Water has collected regular water level data for up to 70 years while third-party data has been collected and reported to Valley Water continuously since 1936 in downtown San Jose. Historical data also includes several one-time measurements at many wells.

Currently, the groundwater level monitoring network has a total of 348 wells, including 171 wells in the Santa Clara Subbasin and 58 in the Llagas Subbasin that are monitored by Valley Water (Table 7-1). To assist in Valley Water's regional evaluation of groundwater conditions, several water retailers provide water level data from 119 of their production wells, most of which are measured monthly or more frequently (Table 7-1). All data collected is maintained in Valley Water's database and is used in regional condition and trend analysis. Groundwater level

monitoring frequency is summarized in Table 7-1, with well locations shown in Figures 7-1 and 7-2. Appendix K includes detailed information on well location, construction, and measurement.

Table 7-1. Groundwater Level Monitoring Frequency

Frequency	Santa Clara Subbasin		Llagas Subbasin		Total
	Valley Water-Monitored Wells	Retailer-Monitored Wells[1]	Valley Water-Monitored Wells	Retailer-Monitored Wells[1]	
Daily	69	0	15	0	84
Twice Monthly	0	23	0	0	23
Monthly	102	84	43	12	241
Total	171	107	58	12	348

1. Indicates the number of retailer wells for which water level data is provided to Valley Water.

Figure 7-1. Santa Clara Subbasin Groundwater Level Monitoring Wells

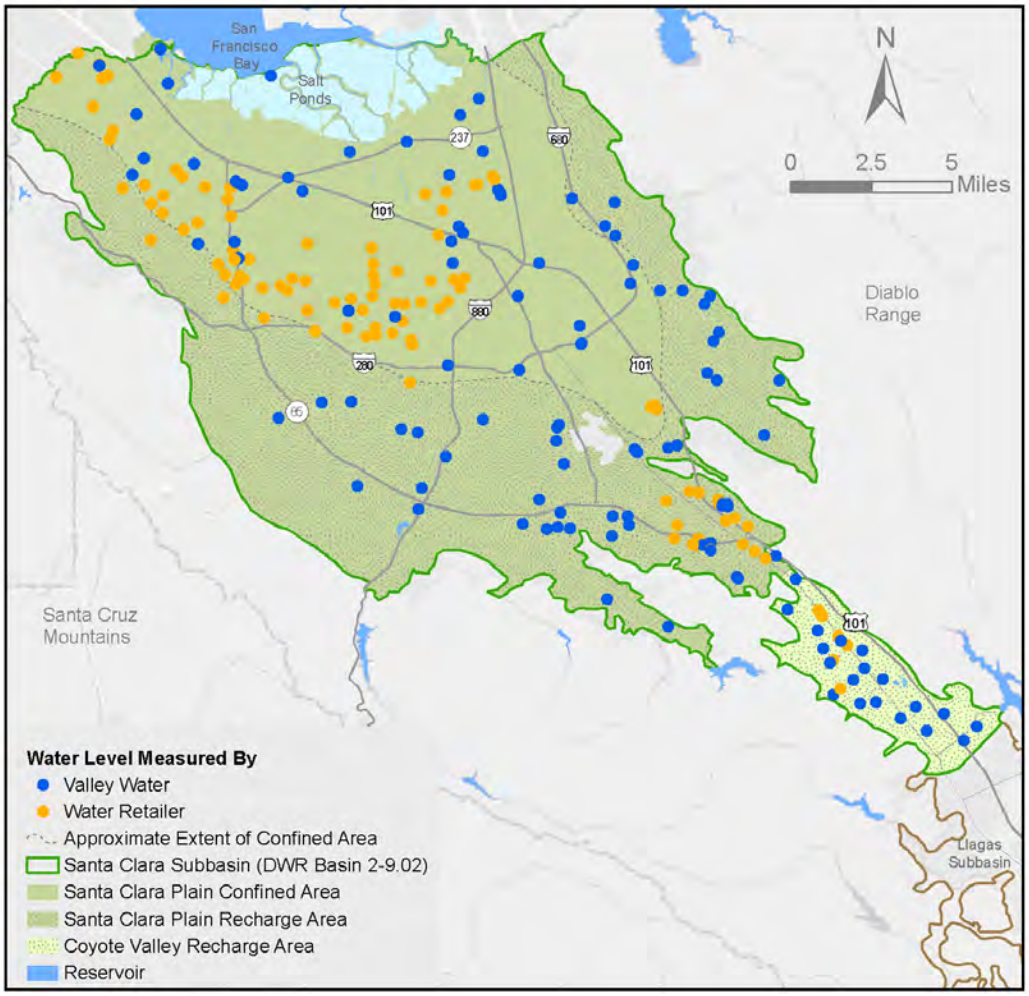
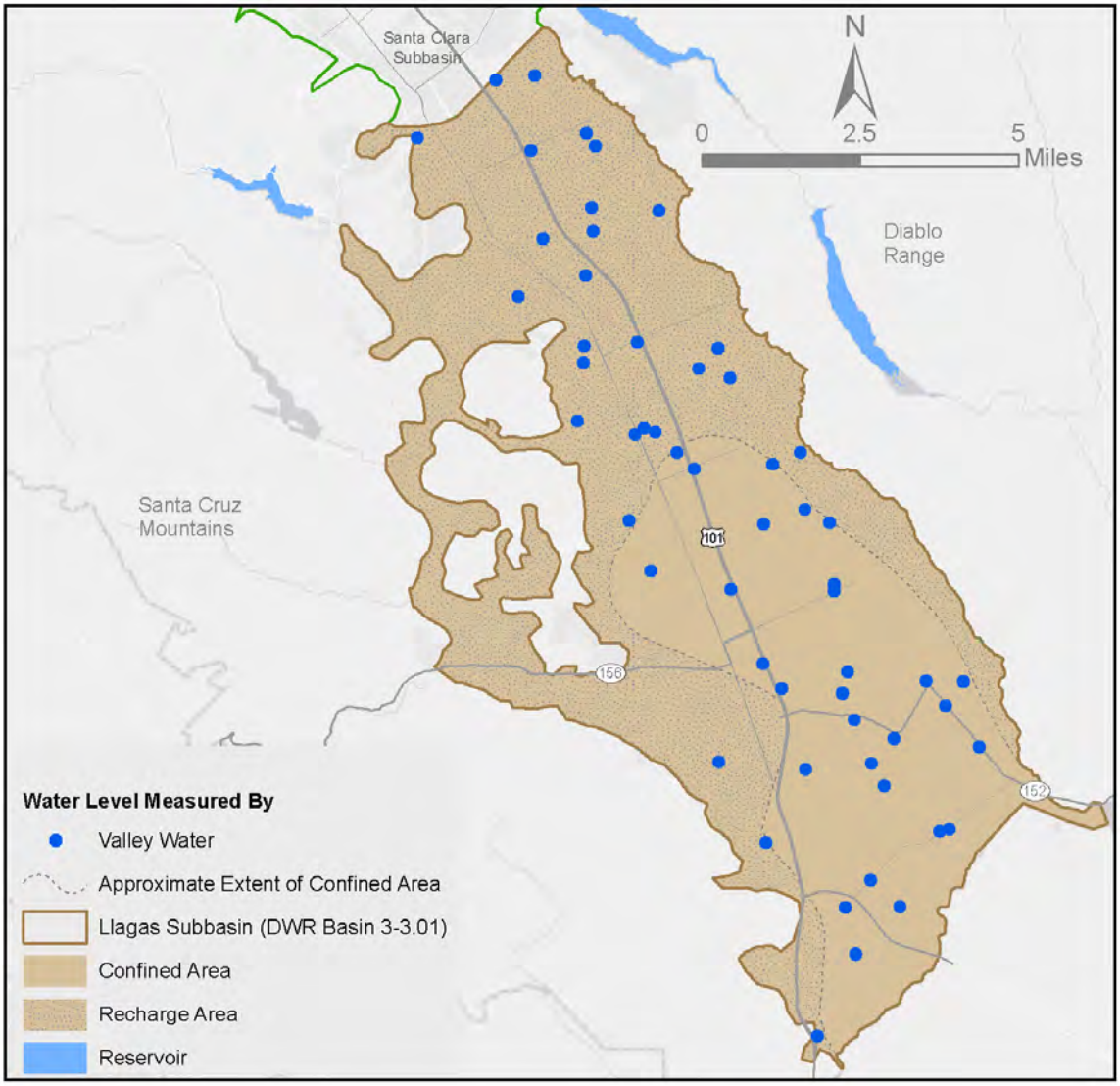


Figure 7-2. Llagas Subbasin Groundwater Level Monitoring Wells



7.1.2 Measurement Methodology

This section presents Valley Water methodology to measure groundwater levels, including information on reference points, depth to water measurements, and instrument calibration.

7.1.2.1 Ground Surface and Measuring Point Elevation Measurement

Valley Water has recently completed land surveys at all groundwater level monitoring wells Valley Water measures. Therefore, currently all Valley Water monitoring wells have elevation accuracy of +/- 0.01 feet.

Depending on the well monitored, the depth to water reading may be taken from various measuring points, including the top of the well casing, lip of utility vault, or other point. Measuring point elevations are generally determined by land surveying.

7.1.2.2 Manual Depth to Water Measurement

Manual depth to groundwater measurements are obtained with the use of electric sounders, steel tapes, air lines, and pressure gauges. Whenever possible, depth to groundwater is measured in wells that have not been pumped recently; otherwise, the measurement is flagged as a pumping water level. More than 98% of the nearly half million water level records maintained in Valley Water's database are static measurements made at wells that have not been pumping. When pumping readings are obtained from water retailers or agricultural wells they are generally not entered into the database as a value, but instead a code is entered to indicate that a reading was attempted. Valley Water's Standard Operating Procedure (SOP) entitled "Manually Measuring and Downloading Depth to Groundwater in Wells" is the controlling document for water level measurement and it is regularly reviewed and updated as necessary.

Table 7-2 summarizes Valley Water's measurement methods and corresponding accuracy. Electric sounders are the method most commonly used by Valley Water to obtain groundwater level readings. The accuracy of electric sounders is generally ±0.1 feet in production wells and can be within 0.05 feet in monitoring wells. These sounders use a long tape measure/wire on a reel attached to a weighted electric sensor. The sensor is lowered to contact water standing in a well to complete a circuit and sound an audible alarm. Once the alarm sounds, the technician records the water depth from an established measuring point as indicated on a graduated tape. Subtracting the depth to water from the measuring point elevation provides the groundwater elevation with respect to mean sea level.

Table 7-2. Manual Depth to Water Measurement Methods and Accuracy

Device	Accuracy (feet)
Airline	± 1
Electric Sounder	± 0.05 to ±0.1
Pressure Gauge	± 0.5
Pressure Transducer	± 0.01
Steel Tape	± 0.1

Electric sounders, pressure gauges and pressure transducers are Valley Water's most common water level measurement methods. Approximately forty wells are under artesian pressure during at least part of the year, particularly during years with above-average rainfall or below-average pumping. Artesian pressure is measured by attaching a pressure gauge to a fitting on the wellhead. The pressure is measured in PSI (pounds per square inch) and converted to feet of equivalent head of water above the measuring point using a multiplier of 2.307 ft per PSI. This is the level the water would rise to if the well casing extended that far above the ground. However, it is not the level to which water would rise if the well were uncapped, as pressure quickly dissipates and well efficiency impedes high pressure flows. Valley Water has equipped many of the artesian monitoring wells with pressure transducers, dataloggers, and telemetry equipment. All artesian wells are equipped with fittings to allow pressure readings when they are under artesian pressure.

In a small number of actively monitored agricultural wells a layer of oil may be present on the water surface. In these wells a steel tape is used to measure depth to water beneath the oil layer since electric sounders are ineffective and become contaminated. A steel tape is weighted and marked with graduated distance lines. The oil layer thickness is not measured, but it is not expected to significantly affect the data. The end of the tape is chalked so that the field technician can confirm the water contact location.

Air lines are used by some water retailers to apply air pressure to a calibrated tube whose end is submerged in the well. In the airline method, the water level is determined by calculating the head corresponding to the maximum air pressure required to displace water in the tube.

7.1.2.3 Automated Depth to Water Measurement

Valley Water uses pressure transducers and data loggers in 87 wells throughout the Santa Clara and Llagas subbasins to measure water levels daily (Appendix K). These daily levels provide a more complete picture of water level changes than can be obtained by monthly electric sounder readings. Telemetry equipment has been installed at 23 of these locations, covering 34 wells since some locations have multiple wells, allowing remote data retrieval over the cellular phone network.

The pressure measured by a transducer must be corrected to remove the influence of atmospheric pressure. Using data from a barometer connected to a data logger and telemetry system, raw pressure data is adjusted to remove barometric pressure, resulting in the pressure of the water above the transducer. Then, using the sensor depth and ground elevation, the depth to water and the water elevation is determined. See below for more detail.

When desired, Valley Water's water level automation system permits the collection of nearly continuous data to observe responses to hydrologic events such as rainfall, recharge operations, and pumping, while also reducing staff time required for collecting water level data. Pressure transducer measurements are validated against manual measurements as described below.

7.1.2.4 Water Level Instrument Calibration

Water level measurement accuracy depends on the accuracy of the measuring instruments. Staff periodically checks water measurement equipment for accuracy and performs calibration if necessary. Electric sounders are generally highly accurate and reliable, with little changes in accuracy over time. If electric sounders are found to be out of calibration, a correction factor is applied to the measurements. A correction factor is added to the pressure measurements as needed. Staff controls for potential instrumental drift in pressure transducers by comparing their readings to manual readings from either the electric sounders or the pressure gauges, depending on whether the well is artesian or not. The pressure transducers are checked for drift monthly as new electric sounder or pressure gauge measurements are obtained. During the conversion of the pressure reading from PSI to feet, a correction factor is applied offset the drift and bring the transducer measurements in line with the manual depth to water readings.

7.1.3 Data Management

Water level data management includes converting the raw data to groundwater elevation, validating and approving the data, and storing the data in a secure database. Data conversion involves transforming depth to water and pressure measurements to groundwater elevations. For depth to water measurements, the field readings are subtracted from the measuring point elevations to get groundwater elevations. To measure artesian wells, pressures are converted into feet of water (head) above the measurement points. These heads are then added to the measuring point elevations to get groundwater elevations. Converting pressure transducer measurements in non-artesian wells involves several steps. First, atmospheric pressure (recorded within an hour of the measurement) is removed from the total pressure to obtain the water pressure above the transducer. These water pressures are then converted to feet of water above the sensor. Using the measured depth of the sensor, head readings are converted to groundwater elevations.

To ensure data is accurate, Valley Water validates groundwater level data collected in the field prior to database upload. Valley Water compares new measurements to historic water levels as an initial screening criterion, and tentatively validates manual measurements that are within historic norms. Values that fall outside of the historic

data are further inspected to determine if there were collection errors. Elevations generated by transducers are checked by comparing them to concurrent manual depth to water measurements. When discrepancies are detected, new conversion factors are generated, and the data is reprocessed to bring the data within ± 0.5 feet of the manual measurement. As a final step in validation, the new data is graphed with recent historic data to look for outliers and continuity. Suspect data points are investigated for validity. The valid data is then transferred to an Electronic Data Deliverable (EDD).

Data approval involves spot checking EDD data for accuracy. If errors are found, the data for that well is reprocessed. Once all known errors are corrected, the data is uploaded to a permanent, secure database. Our database is an industry standard enterprise system with limited write access, and it uses standard data validation and integrity protocols.

7.1.4 Reporting and Communication

Water level data is reported or made available in a variety of formats. Valley Water's monthly Water Tracker includes high-level information on regional index wells in the Santa Clara Plain, Coyote Valley, and Llagas Subbasin. The monthly Groundwater Condition Report provides more detail, presenting water levels for 11 monitoring wells with greater spatial distribution across the subbasins, including the three regional index wells, as well as monthly estimates of pumping and recharge. Valley Water generates potentiometric surface maps (groundwater elevation contour maps) for the spring and fall each year for inclusion in Valley Water's Annual Groundwater Report. This report also provides information on current water level conditions compared to the previous year and long-term conditions. Valley Water has been the Designated Monitoring Entity for Santa Clara County under the California Statewide Groundwater Elevation Monitoring Program (CASGEM) program and updates the DWR CASGEM database with water levels from water level monitoring wells quarterly. As required by DWR, Valley Water will begin reporting groundwater level data in the Monitoring Network Module, rather than CASGEM, by the end of 2021. Valley Water also reports water level data and includes groundwater level contour maps in the Water Year Report that is submitted to DWR annually before April 1, as required under SGMA. Valley Water reports are available at www.valleywater.org. All water levels in Valley Water's water level database are also available through an online portal on the Valley Water website, which allows users to find data by entering a location or well number, or by using the map feature.[111]

7.2 LAND SUBSIDENCE MONITORING

Valley Water maintains and monitors a land subsidence monitoring network in the northern portion of the Santa Clara Subbasin (Santa Clara Plain) to determine if land subsidence is occurring or threatening to exceed established subsidence thresholds, as described in Chapter 5. Land subsidence monitoring includes annual land elevation surveys along three established routes and continuous measurement of vertical ground movement at two extensometers (also called compaction recorders). Groundwater level monitoring is an integral part of the land subsidence monitoring program since long-term overdraft and water level decline was the driving force of historical land subsidence in the Santa Clara Plain, as described in Chapter 2. Water levels in ten subsidence index wells are measured at least monthly. Figure 7-3 presents Valley Water's land subsidence monitoring network, including the land survey circuits, extensometers, and water level wells used to track the potential for subsidence. Results of Valley Water's subsidence monitoring is reported in the Annual Groundwater Report and the Water Year Report that is submitted to DWR.

[111] https://gis.valleywater.org/GroundwaterElevations/

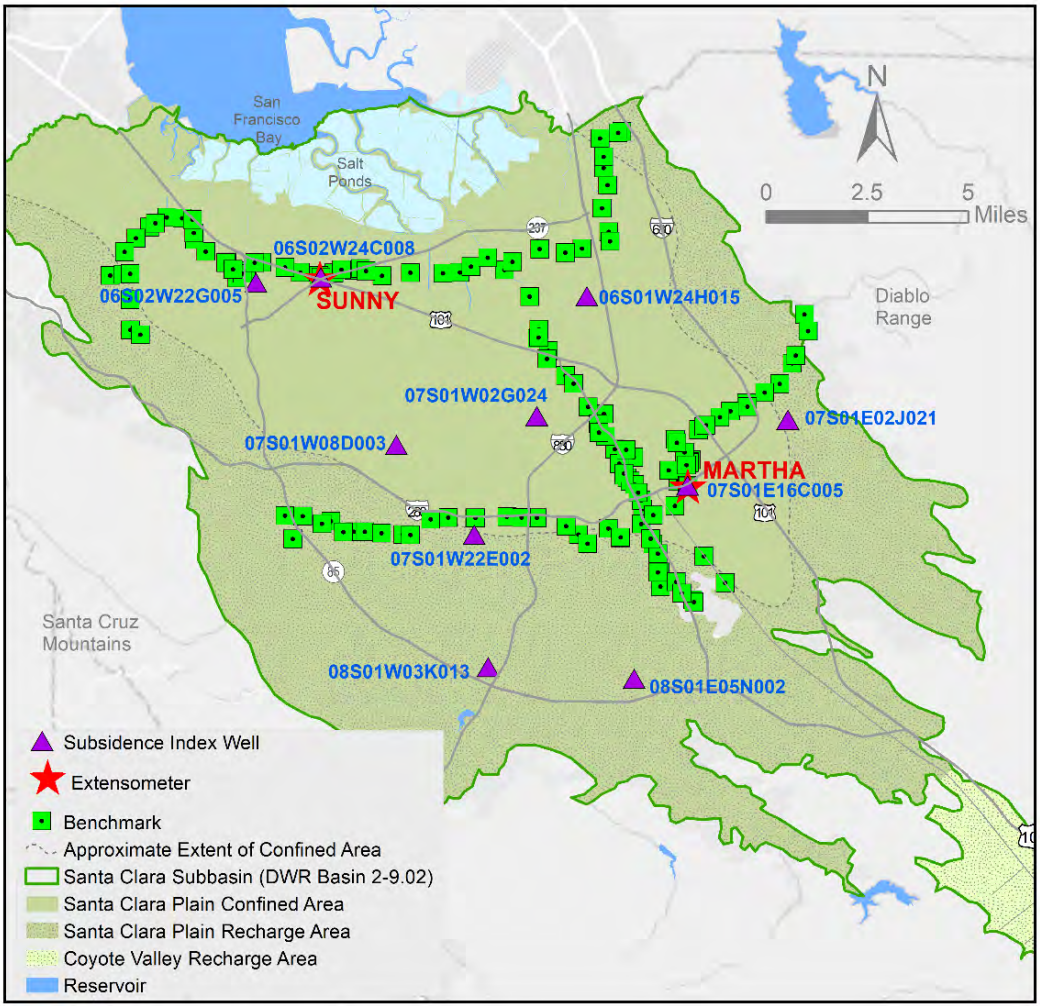
7.2.1 Annual Benchmark Elevation Surveys

Periodic level surveys of land elevation have been conducted in northern Santa Clara County to gauge land subsidence induced by groundwater overdraft since 1934.[112] Valley Water conducts annual surveys each fall to determine the elevations of about 140 survey benchmarks along two east-west circuits and one north-south circuit in the Santa Clara Plain (Figure 7-3). Changes in benchmark elevations are tracked year to year and are evaluated with data collected at extensometers and subsidence index wells.

7.2.2 Extensometer Monitoring

Valley Water collects data from two extensometers installed by the USGS in 1960 to monitor the magnitude and rate of subsidence in the Santa Clara Plain. The USGS terminated its field monitoring in 1983, at which time the extensometer monitoring was transferred to Valley Water. The extensometer sites are in Sunnyvale near Moffett Field ("Sunny") and near downtown San Jose ("Martha") and are continuously monitored for subsidence (Figure 7-3). Water level measurements are also recorded at both extensometer sites.

Figure 7-3. Valley Water Land Subsidence Monitoring in the Santa Clara Plain



[112] Poland and Ireland, Land Subsidence in the Santa Clara Valley, California, as of 1982, 1988.

The extensometers measure vertical ground motion relative to a point 1,000 feet deep using a pipe set beneath the water-bearing aquifers that have the potential to compress and cause subsidence. To measure the change in land surface elevation, it is assumed that the pipe is fixed at the bottom and that the sediment between the pipe bottom and the land surface is expanding or compressing. To accurately measure these land surface changes, Valley Water uses several redundant instruments. The primary instrument is a linear potentiometer, which is calibrated to convert voltage readings into land surface elevation changes with an accuracy of ± 0.0001 feet. Hourly readings (averaged from 10-minute measurements) are stored in a data logger that sends the data to Valley Water via cellular-based telemetry. Valley Water also records readings from a dial gauge, which has an accuracy of ± 0.0001 feet, and a graduated tape that has an accuracy of ± 0.01 feet. Lastly, a paper drum chart continuously records land elevation changes. Readings from the linear potentiometer and the dial gauge are entered into a Valley Water database. Figure 7-4 shows the San Jose (Martha) extensometer and instrumentation.

Figure 7-4. San Jose ("Martha") Extensometer

7.3 GROUNDWATER QUALITY MONITORING

Valley Water conducts ongoing monitoring to assess groundwater quality in the Santa Clara and Llagas subbasins, including regional monitoring, domestic well sampling, and focused monitoring near recycled water irrigation sites and areas of historic seawater intrusion. This section describes Valley Water monitoring, including wells monitored,

parameters analyzed, monitoring frequency, and reporting. It also provides information on monitoring by water retailers and other agencies.

The goal of Valley Water's groundwater quality monitoring is to collect data to support the evaluation of the following:

- Regional groundwater quality conditions for the shallow (<150 feet) and principal aquifers (>150 feet) of the Santa Clara and Llagas subbasins
- The extent and severity of contamination, including the presence of contaminants above drinking water standards,
- Changes in water quality over time,
- Potential threats to the long-term viability of groundwater resources, and
- Groundwater Management Plan outcome measures and associated outcome measure-lower thresholds.

7.3.1 Regional Groundwater Quality Monitoring

For regional groundwater quality monitoring, Valley Water characterizes two aquifer systems, the shallow and the principal aquifer zones. The shallow aquifer combines all water-bearing zones above a depth of 150 feet, which is approximately the base of regional confining layers in both the Santa Clara and Llagas subbasins. There are some exceptions, but generally wells completed in the shallow aquifer are not used for drinking water. The principal aquifer zone is comprised of wells greater than 150 feet deep, where most water supply wells are screened.

7.3.1.1 Valley Water Regional Groundwater Quality Monitoring Network and Frequency

Like Valley Water's water level monitoring network, wells included in the groundwater quality monitoring network include Valley Water installed monitoring wells, monitoring wells Valley Water has obtained, and privately-owned wells, including active domestic, agricultural wells, and other water supply wells. Valley Water constructed multi-level nested monitoring wells at nine locations in the Santa Clara Plain in cooperation with the USGS. These wells allow depth-discrete sampling to discern water quality variation with depth, with the deepest casings at some wells extending below 1,000 feet.

The groundwater quality monitoring network in the Santa Clara Subbasin comprises 52 wells, the distribution of which is presented in Table 7-3 and Figures 7-5 and 7-6. The Santa Clara Plain Baylands is the area near San Francisco Bay that has historically been affected by seawater intrusion (see Appendix H for additional details about seawater intrusion). The Llagas Subbasin monitoring network is comprised of 37 wells as shown in Table 7-4 and Figures 7-7 and 7-8. This data is augmented by data collected by water retailers at over 230 wells each year as described in Section 7.3.2. Detailed information on the location and construction of all wells monitored by Valley Water is in Appendix K. Changes to groundwater quality network wells and frequency to address data gaps are recommended and further discussed in Appendix J.

Table 7-3. Santa Clara Subbasin Regional Groundwater Quality Monitoring Summary

Area	Shallow Aquifer Zone	Principal Aquifer Zone	Total
Santa Clara Plain Baylands	17	--	15
Santa Clara Plain	11	18	31
Coyote Valley	--	6	6
Total	28	23	52

Note: Coyote Valley does not have distinct shallow and principal aquifer zones due to the lack of regional confining layer.

Table 7-4. Llagas Subbasin Groundwater Quality Monitoring Summary

Area	Shallow Aquifer Zone	Principal Aquifer Zone	Total
Llagas Subbasin	14	23	37

Valley Water collects samples from all groundwater quality monitoring wells annually in the fall. The frequency of analysis for specific parameters varies per a fixed schedule depending on persistence or variability of that parameter as shown in Table 7-5 and described further in the next section.

Table 7-5. Valley Water Regional Groundwater Quality Monitoring Analytical Schedule

Monitoring Wells	Parameters Groups Monitored and Frequency				
	Major Ions	Nutrients	Trace Elements	VOCs	Chloride, pH, EC
Regional Monitoring Wells	Annual	Annual	Annual	Triennial	Annual
Seawater Intrusion Monitoring Wells	Triennial	Triennial	Annual	--	Annual

Note: the seawater intrusion monitoring wells are included in Table 7-3 as the Santa Clara Plain Baylands wells.

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Figure 7-5. Santa Clara Subbasin Shallow Aquifer Groundwater Quality Monitoring Network

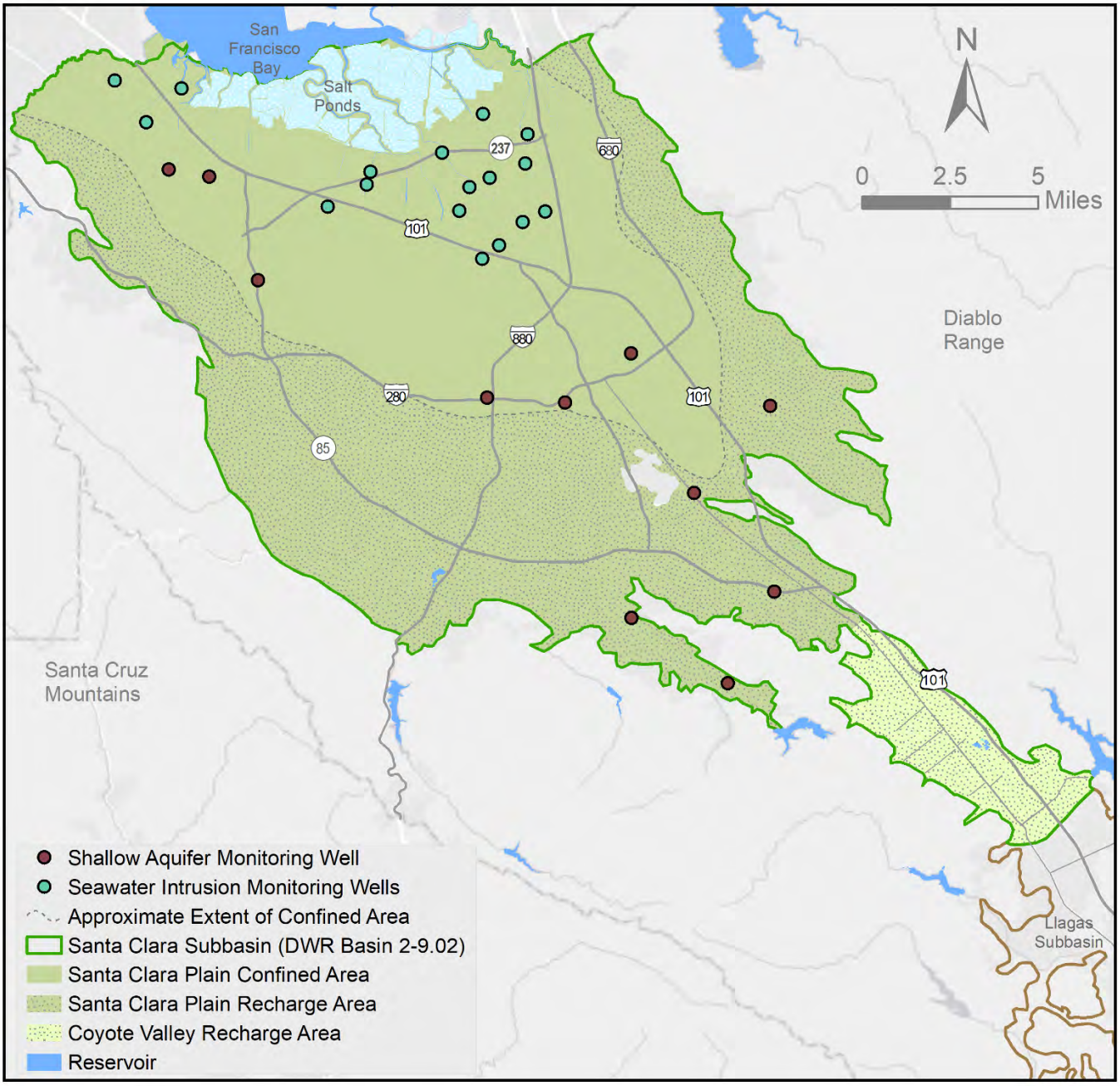

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Figure 7- 6. Santa Clara Subbasin Principal Aquifer Groundwater Quality Monitoring Network

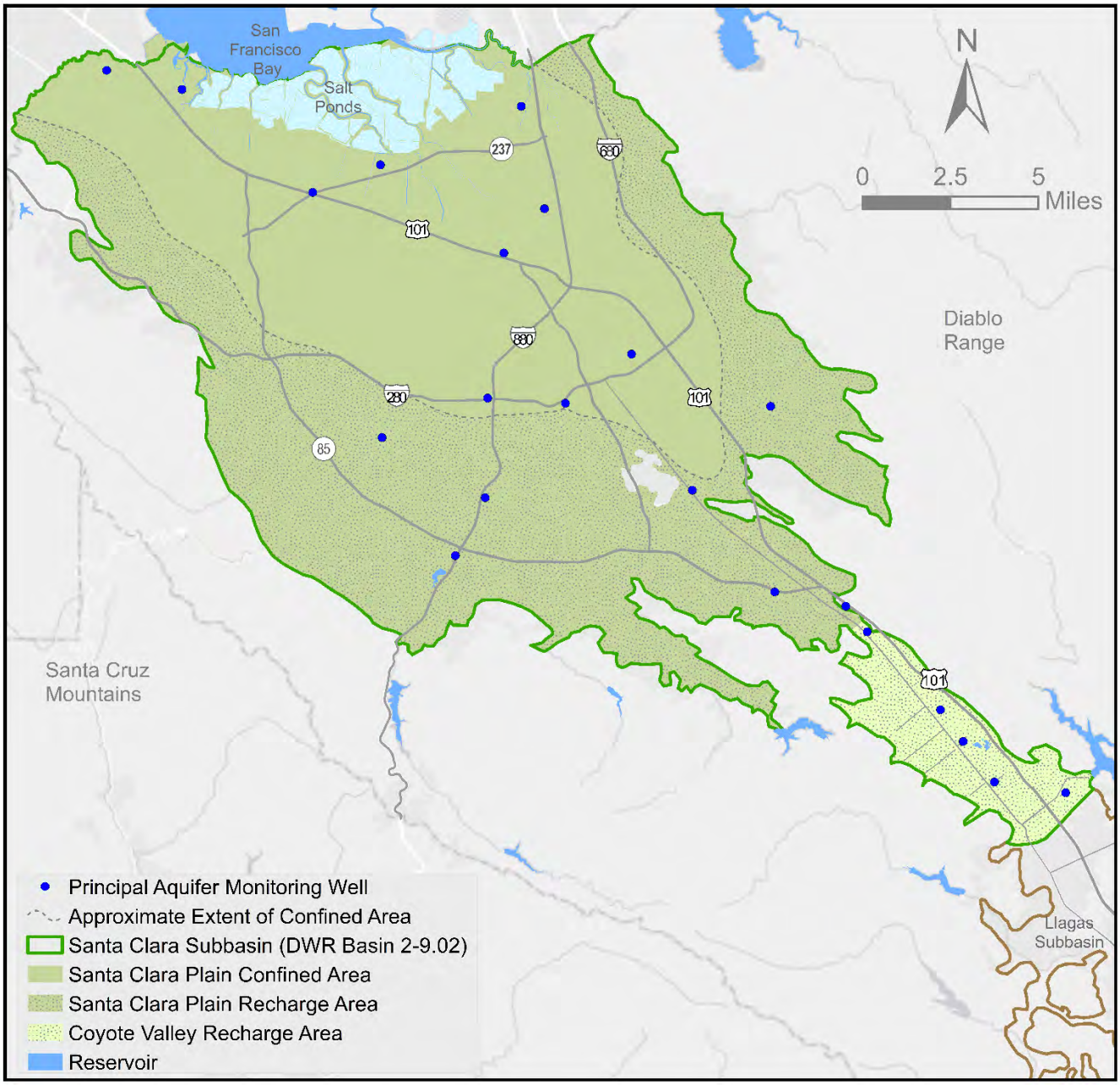

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Figure 7-7. Llagas Subbasin Shallow Aquifer Groundwater Quality Monitoring Network

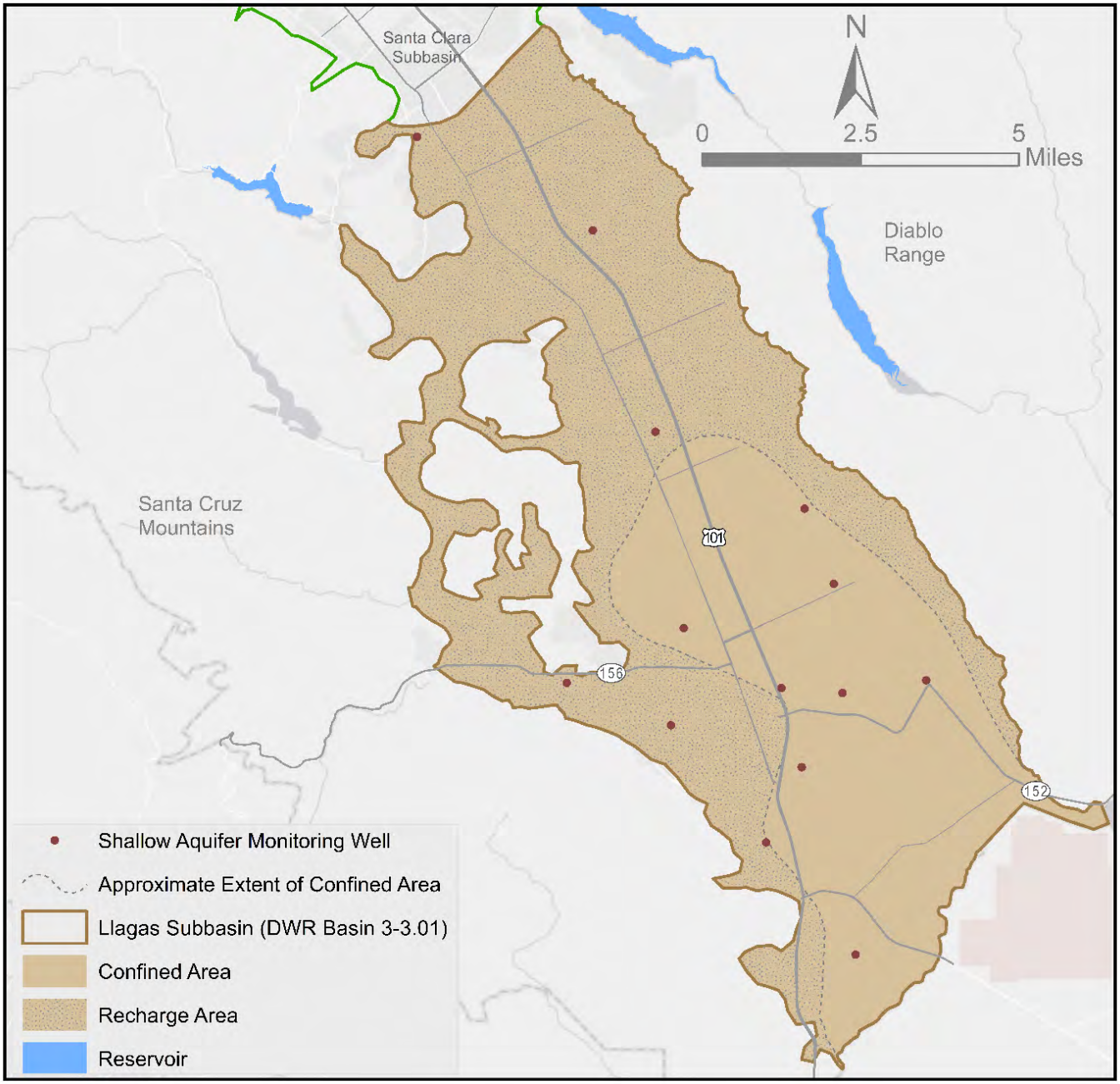

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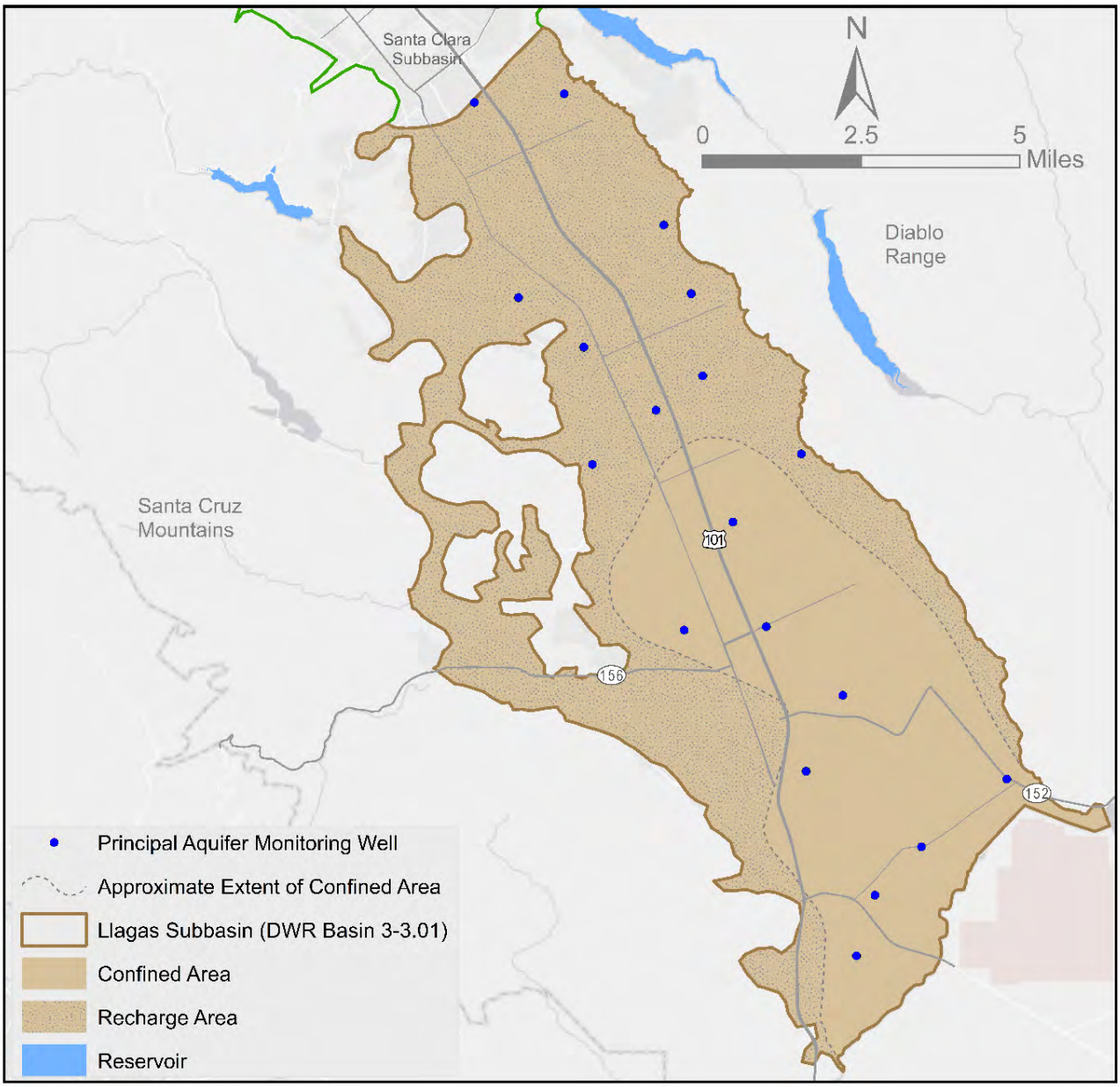
Figure 7-8. Llagas Subbasin Principal Aquifer Groundwater Quality Monitoring Network



7.3.1.2 Monitoring Parameters

Each fall, Valley Water analyzes major and minor ions and nutrients at all wells (Table 7-5). Major inorganic parameters analyzed include calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, and silica. These common parameters account for the vast majority of all dissolved matter in water derived from natural sources. Valley Water also analyzes common metals, nutrients, salts, and field parameters as shown in Table 7-6.

Every three years, Valley Water monitors volatile organic compounds (VOCs) at all wells (Table 7-5). Although detections of VOCs are rare in the principal aquifer zone, with many VOC contaminant release sites in the county, it is prudent to occasionally analyze the water for VOCs.

Local groundwater has been analyzed for pesticides in the past by Valley Water and water retailers. The results have been primarily non-detect with only sporadic, isolated detections at very low levels. The need for future pesticide analysis by Valley Water will be evaluated over time based on changes in drinking water standards, changes in land use, and public water system sampling results.

While not currently regulated in drinking water, Per- and Polyfluoroalkyl Substances (PFAS) are of increasing concern and have been detected in both the Santa Clara and Llagas subbasins. Voluntary regional monitoring by Valley Water indicates PFAS are not widely detected above current state health-advisory levels. However, one water retailer has removed 10 water supply wells from service due to detections of PFAS in 2020. The technical knowledge and regulatory requirements for PFAS are rapidly changing. Valley Water will continue to monitor developments related to PFAS and will evaluate the need to include PFAS analysis for Valley Water monitoring wells.

Table 7-5 presents the monitoring schedule and parameters to be tested in each regional well monitored by Valley Water, with associated analytical methods in Table 7-6. The list of parameters monitored and relative analytical methods is expected to be somewhat dynamic over time depending on field conditions, new information or methods as regulatory requirements change, or identification of potential new water quality concerns. Additional contaminants may be analyzed as necessary to evaluate specific threats or concerns as they arise. Analysis of some parameters may be discontinued if multiple sampling events show the analytes are not present. Any changes in the parameter list will be reflected in each five-year update of the GWMP.

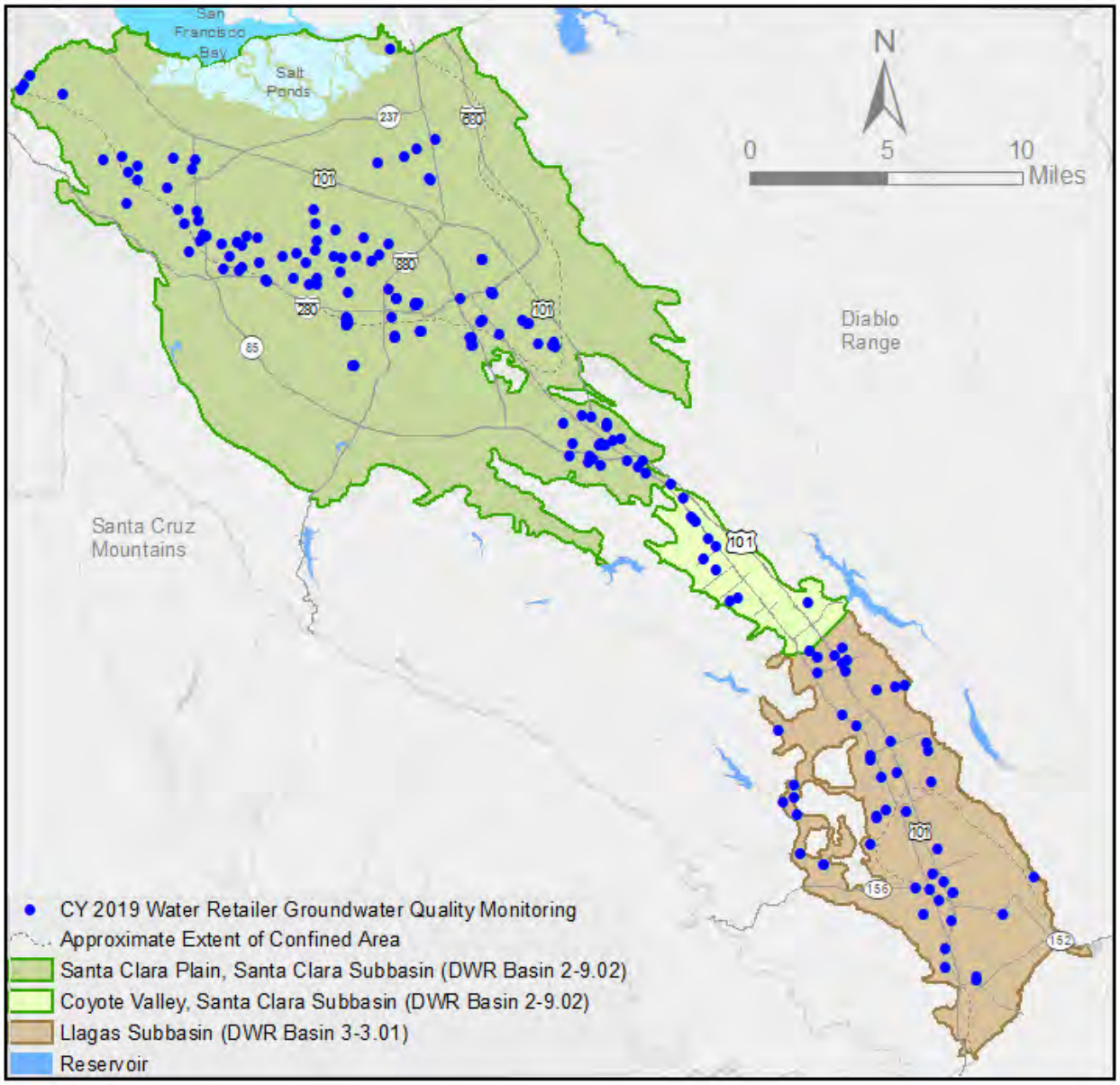
Table 7-6. Valley Water Regional Groundwater Quality Monitoring Parameters and Analytical Methods

Parameter Group	Parameter	Analytical Method
Trace Elements	Aluminum, Boron, Iron, Lithium, Zinc	EPA 200.7
	Antimony, Arsenic, Barium, Beryllium, Chromium (Total), Cobalt, Copper, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium	EPA 200.8
	Mercury	EPA 245.1
	Chromium 6	EPA 218.7
Ions	Alkalinity, Bicarbonate	SM2320B
	Total Dissolved Solids	SM2540C
	Chloride	SM4500-Cl
	Calcium, Magnesium, Potassium, Silica, Sodium	EPA 200.7
	Fluoride, Bromide, Sulfate	EPA 300.0
	Hardness	SM2340 C
	Perchlorate	EPA 314.0
Nutrients	Nitrate, Phosphate	EPA 300.0
Field	pH, Specific Conductance, Temperature	Field
VOCs	All VOCs included in method EPA 524 (analyzed every three years)	EPA 524

7.3.2 Public Water Supplier Monitoring

Local water retailers and other public water suppliers serving groundwater analyze well water samples to comply with DDW requirements and support operational decisions. In general, compliance monitoring is completed at least once every three years following a schedule set by DDW. Each year, Valley Water obtains groundwater quality data from DDW for all public water systems in Santa Clara County, including water retailers and mutual water companies subject to DDW monitoring. Valley Water uploads this data to Valley Water's database and uses it with Valley Water-collected data in the annual evaluation of groundwater quality in the Santa Clara and Llagas subbasins. In 2019, Valley Water obtained DDW water quality compliance data from 232 production wells, as shown on Figure 7-9.

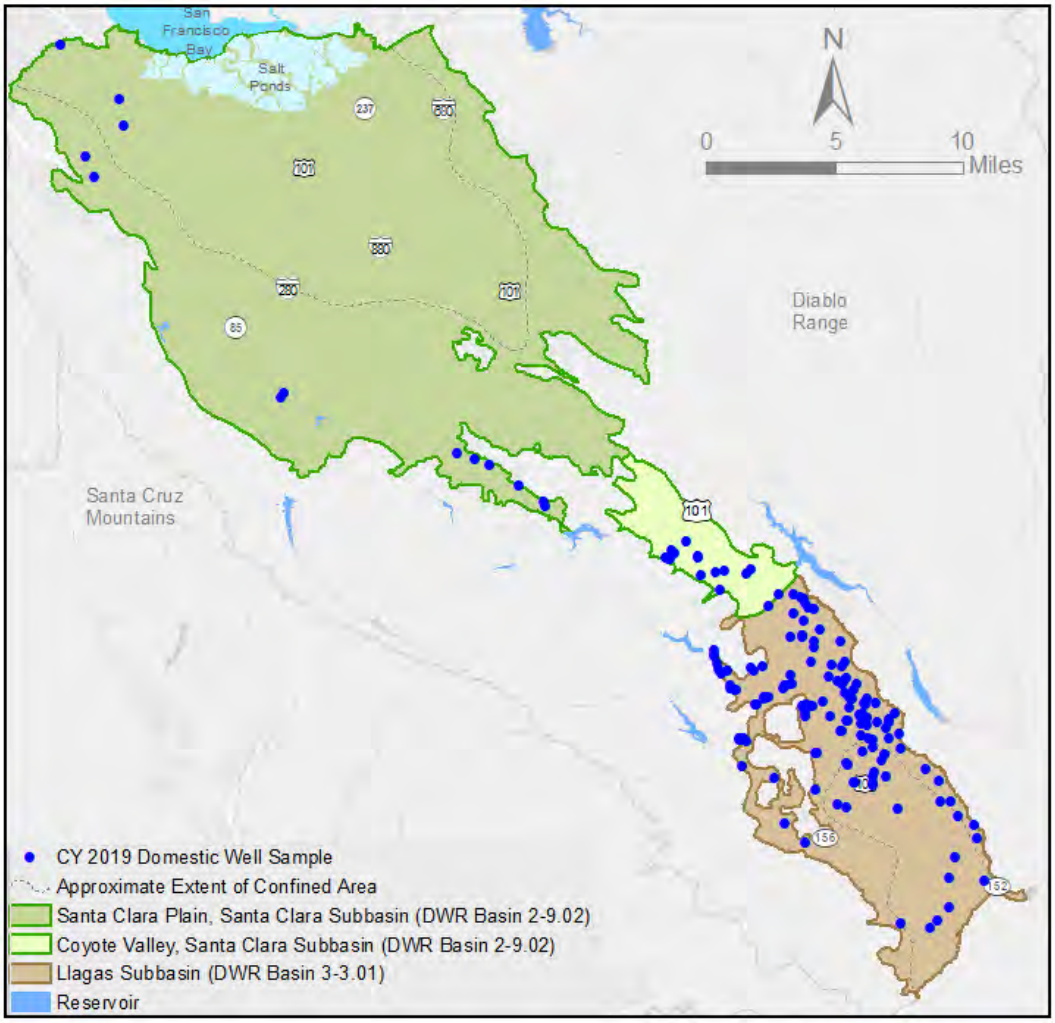
Figure 7-9. Public Water Supplier Groundwater Quality Monitoring (2019)



7.3.3 Domestic Well Testing Program

Valley Water offers free basic water quality testing once a year to eligible domestic well owners within Valley Water's groundwater benefit zones. In 2019, Valley Water tested more than 140 domestic wells for basic water quality parameters including nitrate, bacteria, total dissolved solids (TDS), and hardness. Domestic well data helps improve Valley Water's understanding of the occurrence of common contaminants and helps well owners understand their well water quality. Because it is a voluntary program, the wells tested vary each year. Figure 7-10 presents the locations sampled in calendar year 2019.

Figure 7-10. Valley Water Domestic Well Testing Locations (2019)

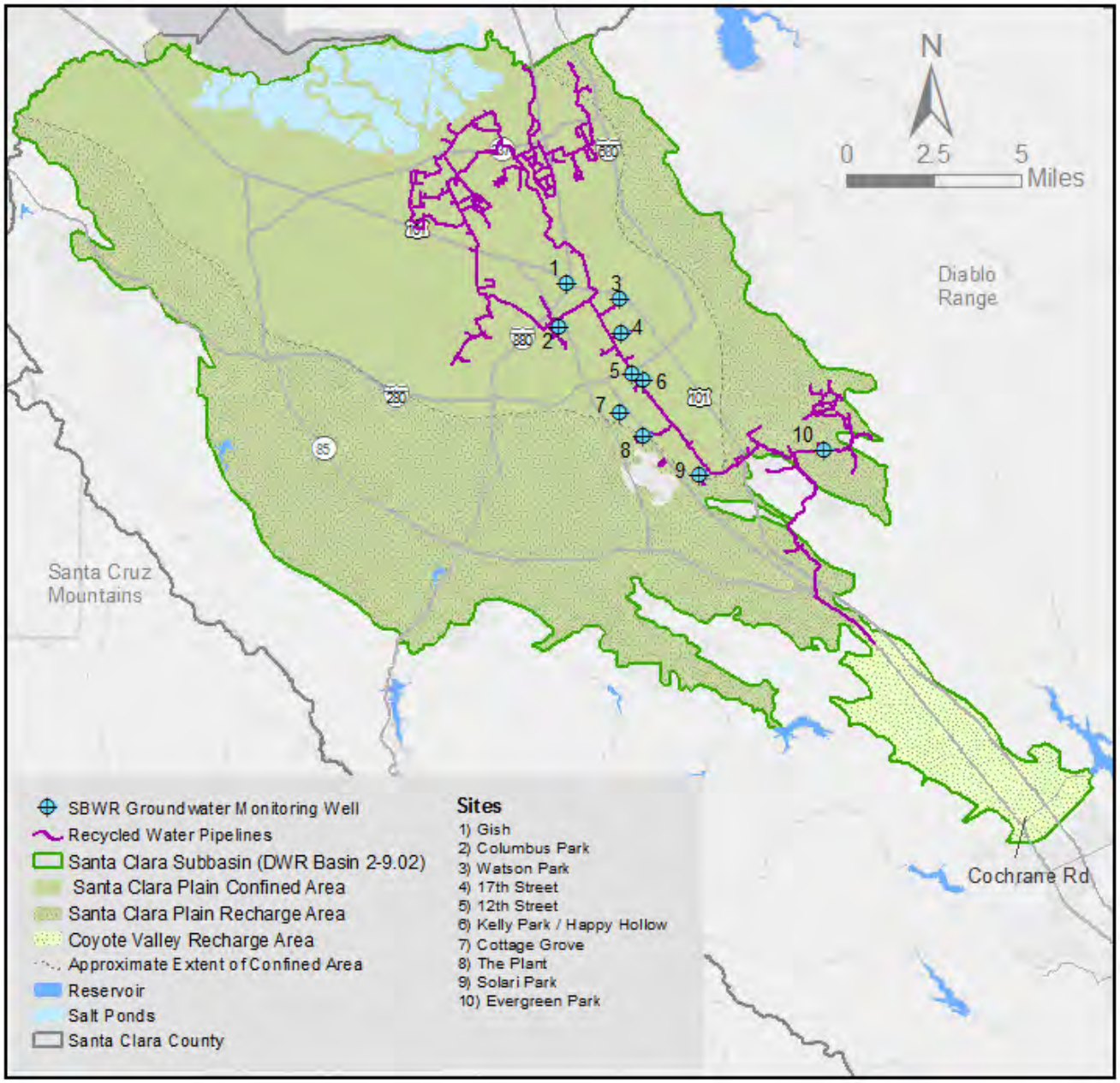


7.3.4 Monitoring Near Recycled Water Irrigation Sites

Tertiary-treated recycled water generally has a higher concentration of salts, nutrients, disinfection by-products, and emerging contaminants than local groundwater or treated potable water. Recycled water is used for non-potable uses like landscape irrigation, agriculture, and industry. To ensure groundwater resources are protected as recycled water use expands, Valley Water currently monitors wells at several recycled water irrigation sites in the Llagas Subbasin and in the past has monitored and evaluated data from monitoring wells at the Integrated Device Technology (IDT) site in the Santa Clara Subbasin. Valley Water also evaluates data collected by South Bay Water

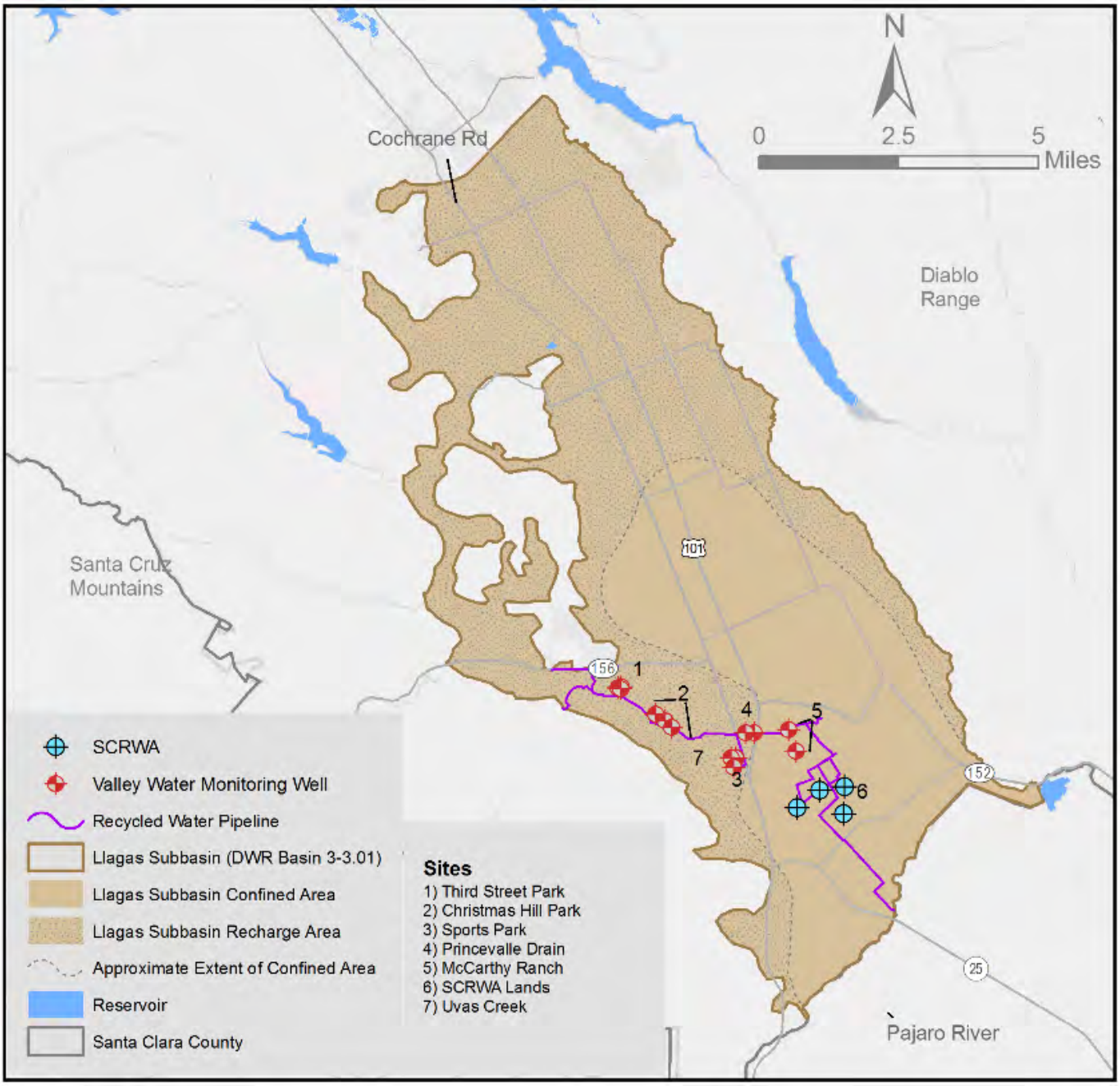
Recycling (SBWR) from monitoring wells near recycled water irrigation sites in the Santa Clara Subbasin. Figures 7-11 and 7-12 show the location of active monitoring wells. Appendix K presents the basic well construction details for Valley Water recycled water irrigation site monitoring wells.[113]

Figure 7-11. Santa Clara Subbasin Groundwater Quality Monitoring Near Recycled Water Irrigation Sites



[113] This section summarizes the wells, parameters, and monitoring frequency that are currently in place for the Recycled Water Monitoring Program. However, the wells, parameters, and/or monitoring frequency may change in the future depending in response to changing conditions.

Figure 7-12. Llagas Subbasin Groundwater Quality Monitoring Near Recycled Water Irrigation Sites



7.3.4.1 Valley Water Recycled Water Irrigation Site Monitoring Network and Frequency

Valley Water monitors several sites (comprising 20 monitoring wells) in the Llagas Subbasin to support expanded recycled use per the South County Recycled Water Supply Master Plan Project Environmental Impact Report (South County EIR).[114] Wells near recycled water irrigation sites in the Llagas Subbasin have been monitored quarterly since monitoring began in 2012 or later, depending on the well. Quarterly monitoring was chosen because it met (and

[114] Santa Clara Valley Water District, 2011 South County Recycled Water Master Plan Project: Environmental Impact Report.

exceeded) the terms of the South County EIR, which required semiannual monitoring for at least the first three years the groundwater monitoring wells were in operation.[115] Quarterly monitoring has since been reduced to twice-yearly monitoring because the terms of the South County EIR were met and a recent statistical analysis demonstrated that data quality/resolution would not be comprised.

7.3.4.2 Valley Water Monitoring Parameters

Parameters analyzed by Valley Water for groundwater wells and recycled water source samples are shown in Table 7-7. Together, these parameters have chemical characteristics that are likely to provide reliable indication of changes resulting from the use of recycled water for irrigation. The selected parameters fall into five general categories: basic water quality parameters, disinfection by-products, organic parameters, other parameters of interest, and field parameters.

Basic water quality parameter data allows Valley Water to determine existing quality and the geochemical make-up of groundwater at each site. If recycled water is affecting shallow groundwater, this will likely shift the geochemical make-up of shallow groundwater. Shallow groundwater is typically dominated by calcium, magnesium, and bicarbonate, whereas recycled water tends to be dominated by sodium, chloride, and bicarbonate. A gradual shift in the groundwater geochemical make-up to one dominated by salts could indicate changes from recycled water use.

Disinfection by-products are primarily dissolved organohalogens from the breakdown of organic substances during treatment with a chemical disinfectant. Disinfection by-products are generally harmful at low concentrations and therefore are included in the list of Valley Water monitoring parameters. They include parameters such as trihalomethanes, haloacetic acids, and NDMA.

Other parameters of interest include those introduced as part of the influent to the wastewater treatment plant (WWTP) that may not be fully removed during treatment. These include parameters like cleaning agents, herbicides, and constituents of emerging concern (CECs) such as Per- and polyfluoroalkyl substances (PFAS). The four recycled water suppliers in Santa Clara County produce disinfected tertiary recycled water. Per the terms of the California Title 22 reuse requirements, disinfected tertiary recycled water is required to meet stringent standards for total coliform bacteria. Valley Water monitors several microbial parameters, including total coliform bacteria, for groundwater well and recycled water sources. Field parameters are collected for the purposes of comparing general groundwater quality trends over time.

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[115] *Final Program EIR for the South County Recycled Water Master Plan.* Valley Water. March, 2011.

Table 7-7. Valley Water Recycled Water Site Monitoring Parameters and Analytical Methods

Parameter Type	Parameter	Methods
Basic Water Quality Parameters	Metals and Trace Elements	EPA 200.7/200.8
	Inorganics	EPA 300/300.1
	Alkalinity	SM2320B
	Hardness	SM2340C
	Conductivity	SM2510B
	Total Dissolved Solids (TDS)	SM2540C
	Chloride	SM4500Cl D
Disinfection By-products	Haloacetic acids (HAA5[1])	EPA 552.3
Organic Parameters	Volatile Organic Compounds (includes THMs[2])	EPA 524.2
Other Parameters	Nitrosamines[3]	EPA 521
	PFAS[4]	EPA 537.1
	Ethylenediaminetetracetic acid (EDTA)	EPA 300 (MOD[5])
	Surfactants (MBAS)	SM5540C
	Nitrilotriacetic acid (NTA)	EPA 300 (MOD[5])
	Total Coliforms and E. Coli	SM9223B
Field Parameters	Oxygen	Field
	pH	Field
	Source Temperature	Field
	Specific Conductance-Field	Field
	Turbidity-Field	Field

Notes:
1) HAA5 include the following: Dibromoacetic acid (DBAA), Dichloroacetic acid (DCAA), Monobromoacetic acid (MBAA), Monochloroacetic acid (MCAA), and Trichloroacetic acid (TCAA).
2) THMs include the following: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
3) Nitrosamines include the following: N-Nitrosodimethylamine (NDMA), N-Nitrosopyrolidine (NYPR), N-Nitrosodiethylamine (NDEA), N-Nitrosodibutylamine (NDBA), N-Nitrosopropylamine (NDPA), and N-Nitrosometylethylamine (NMEA).
4) PFAS method measures 18 different compounds including Perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA).
5) MOD = modified method.

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7.3.4.3 Other Monitoring Near Recycled Water Irrigation Sites

The City of San Jose's SBWR Program conveys recycled water from the San Jose-Santa Clara Water Regional Wastewater Facility to numerous sites within the Santa Clara Subbasin. As a Water Board condition to implement this program, SBWR implemented the Groundwater Mitigation and Monitoring Plan (GMMP). As part of the GMMP, SBWR monitors groundwater quality in both the confined and recharge areas. The City of San Jose began groundwater quality monitoring in 1997 and recycled water deliveries in the area began in 1998. SBWR currently monitors six deep water supply wells in the confined area and five shallow monitoring wells in the confined and unconfined areas (Figure 7-11).

SBWR analyzes inorganic parameters such as nitrate and TDS. Initially, sampling was conducted monthly but was reduced to a quarterly basis. As of 2006, sampling was reduced to an annual event, which occurs during the first quarter of the calendar year. SBWR provides the annual data to Valley Water to assist in water quality analysis.

7.3.5 Groundwater Quality Monitoring Programs by Other Agencies

The sections below discuss groundwater monitoring performed by agencies other than Valley Water, water retailers, or SBWR within the Santa Clara and Llagas subbasins. Valley Water does not typically use this data for annual basin evaluation and reporting but considers related findings as they become available.

7.3.5.1 GAMA

The Groundwater Ambient Monitoring and Assessment (GAMA) program was created by the Groundwater Quality Monitoring Act of 2001, with the goals of improving statewide groundwater monitoring and increasing the availability of groundwater data to the public. The State Water Resources Control Board's program was carried out by the USGS and Lawrence Livermore National Laboratory (LLNL).

The statewide program uses a consistent study design in all study areas, with spatially distributed networks producing data sets that address basin scale objectives and allow incorporation into regional and statewide assessments. GAMA networks rely primarily on existing public supply wells, with other types of wells (irrigation, domestic supply, or monitoring wells) sampled as necessary to achieve the required spatial distribution. There are four projects under GAMA that have been completed:

- Priority Basin Project: This project initially focused on assessing the deep groundwater resource that accounts for over 95 percent of all groundwater used for public drinking. In 2012, the assessment of shallow aquifer water quality was initiated to provide information on aquifers used for domestic and small community water supplies. Areas of State with the greatest densities of households that rely on domestic wells are prioritized into study units for this phase of the project.
- Geo Tracker GAMA: Geo Tracker GAMA is an on-line database providing water quality data from various sources on an interactive Google-based map. The goal of this system is to provide a centralized system that is available to the public and decision makers.
- Domestic Well Project: The Domestic Well Project collects samples from private wells on a county level. This program is offered free to well owners who volunteer. The water quality data is placed on GeoTracker GAMA without well owner identification.
- Special Studies Project: The Special Studies Project focuses on specific issues of concern to groundwater quality. These studies provide better understanding of groundwater contaminant occurrence, fate and transport.

As a special studies project, LLNL conducted a vulnerability assessment that included Santa Clara County.[116] The Santa Clara Subbasin is included in the San Francisco Bay Study Unit and was last studied in 2007.[117] The Llagas Subbasin is part of the South Coast Interior Groundwater Basins Study Unit and was last studied in 2008.[118] Reports for the State Water Resources Control Board's GAMA investigations including the Santa Clara and Llagas subbasins are available online.

7.3.5.2 Irrigated Lands Program

The State Water Board created the Irrigated Lands Regulatory Program (ILRP) in 2003 to protect state waters from impairment by waste discharge from commercially irrigated lands, which may contain wastes, such as pesticides, nitrate, and pathogens. The ILRP requires all growers to provide a farm evaluation and a nitrogen management plan to identify improvements that can be implemented to protect water quality. Growers will be required to have a certified nitrogen management plan if their groundwater is impacted by or susceptible to impacts from nitrate, pesticides, or other agricultural parameters.[119]

The ILRP for the Llagas Subbasin is overseen by the Central Coast Water Board. The first Irrigated Lands Order was issued in 2004, followed by the second Irrigated Lands Order in 2012 and the third in 2017. The Central Coast Water Board finalized the fourth Irrigated Lands Order (Ag Order 4.0) in April 2021, which will apply to owners and operators of irrigated land used for commercial crop production. The Central Coast Water Board is focusing on priority water quality issues, such as pesticides and toxicity, nutrients, and sediments, with heavy emphasis on nitrate impacts to drinking water sources. Ag Order 4.0 is protective of groundwater and surface water supplies and has an increased focus (relative to past Irrigated Lands Orders) on quantifiable objectives that must be verified through water quality monitoring within a defined time schedule. Ag Order 4.0 includes incentives to use nitrogen in irrigation water to reduce fertilizer nitrogen application and mine groundwater nitrogen from aquifers.[120] In the Llagas Subbasin, the Central Coast Groundwater Coalition has implemented a cooperative monitoring program to comply with previous Irrigated Lands Orders; these programs will be encouraged as part of the Ag Order 4.0 as well.[121] Growers not participating in the cooperative will be responsible for monitoring their own operations to meet Central Coast Water Board requirements. Participants in cooperative monitoring programs or growers conducting individual monitoring must sample groundwater and surface water for analysis of the parameters. Sample data must be entered into the State Water Board's GeoTracker database.

7.3.6 Valley Water Groundwater Quality Monitoring Protocols

This section presents Valley Water sampling protocols for groundwater quality monitoring. These protocols are intended to ensure consistency and produce reliable, quality assured, and representative water quality data. Valley Water's sampling protocol is consistent with best industry practice, which includes following, where applicable, the

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[116] Lawrence Livermore National Laboratory, California Aquifer Susceptibility, A Contamination Vulnerability Assessment for the Santa Clara and San Mateo County Groundwater Basins, 2004. http://www.waterboards.ca.gov/gama/docs/cas_llnl_santaclara_sanmateo.pdf

[117] USGS, Ground-water quality data in the San Francisco Bay study unit, 2007: Results from the California GAMA program: U.S. Geological Survey Data Series 396, 2009.

[118] USGS, Groundwater-quality data in the South Coast Interior Basins study unit, 2008: Results from the California GAMA program: U.S. Geological Survey Data Series 463, 2009.

[119] http://www.swrcb.ca.gov/water_issues/programs/agriculture/docs/about_agwaivers.pdf; https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/ag_order4_renewal.html

[120] https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/ag_order4_renewal.html

[121] Northern Counties Groundwater Characterization: Salinas Valley, Pajaro Valley and Gilroy-Hollister Valley, 2015; https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/ag_order4_renewal.html

USGS National Field Manual.

7.3.6.1 Valley Water Groundwater Quality Sampling Methodology

Well purging removes stagnant water from the well prior to sample collection to allow collection of water quality samples that are representative of the aquifer. When sampling a dedicated monitoring well, Valley Water purges a volume of water equivalent to at least three casing volumes with a portable electric submersible pump. During purging, field measurements of pH, electrical conductivity, temperature, and turbidity are measured and recorded on field data sheets. Monitoring wells generally have turbidity levels of 10 nephelometric turbidity unit (NTU) or lower. When higher turbidity is encountered, the well is pumped longer to determine if lower turbidity can be obtained, and if not, samples for inorganic and metal analytes are filtered in the lab prior to analysis.

Valley Water samples domestic wells by letting well water run through a designated sampling port for at least 5 minutes of continuous pump operation. Since domestic wells are operated frequently, the water in the well is not stagnant, so there is no need to remove a specific volume of water during purging. If a domestic well has sat idle for a month or more, Valley Water performs standard purging procedures.

After the required purging has been performed and field parameters have stabilized, Valley Water collects samples in pre-cleaned and prepared sample bottles, which contain preservatives when required by the analytical method. When sampling for bacteria, the outside portion of the sampling port is first cleaned with isopropyl alcohol and then samples are placed in a secondary container and stored in wet ice. All non-bacteria samples are transported in coolers with enough ice to chill samples to 4 degrees Celsius. Samples collected by Valley Water are recorded on standard chain-of-custody documents.

When collecting groundwater samples for PFAS analysis, Valley Water follows DDW's latest PFAS sampling guidelines[122]. Preventing cross-contamination and ensuring the integrity of groundwater samples are crucial to understanding the occurrence of PFAS in Santa Clara Valley. Special precautions are taken when sampling wells for PFAS including, but not limited to using and wearing acceptable materials when handling and collecting samples, collecting field blanks at each location, storing samples separately on wet ice, and following DDW's recommended eating, staging, and sampling dedicated areas.

Decontamination of portable pumps used for sampling is performed under certain circumstances, which trigger action as shown in Table 7-8. In general, full decontamination with strong detergent is only performed under rare circumstances since Valley Water primarily monitors the potable water supply aquifer as opposed to wells located at or near contaminated sites. This provides a more streamlined and efficient decontamination procedure and protects equipment from corrosive conditions while still minimizing the likelihood of contaminant transfer between well sites.

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[122] State Water Resources Control Board, PFAS Sampling Guidance for Non-Drinking Water, September 2020.

Table 7-8. Equipment Decontamination Levels

Decontamination Level	Description	Triggers
Level 1	• Complete scrubbing of portable pump apparatus with 2% Alconox solution. • Circulation of detergent solution through internal pump assembly. • Complete rinsing with de-ionized (DI) water.	• After a long period of storage (> 6 months). • After encountering unusual water quality condition such as colored water, greasy or oily substances visible, known contamination. • After sampling sites with a high likelihood of contamination (e.g. fueling island, near chemical storage facilities, etc).
Level 2	• Clean and rinse outside portable pump apparatus with DI water or municipal tap water. • Rinse internal pump assembly with DI water or municipal tap water. • Clean and rinse first 5 feet of pump discharge line.	• After sampling water with high TDS (EC > 5,000 µS/cm). • After high nitrate encountered (> 50 mg/L as nitrogen).
Level 3	• Clean and rinse outside of portable pump assembly with DI water or municipal tap water. • Clean and rinse first 5 feet of pump discharge tubing.	• If dirt, mud, dried mineral salts, scum or film are visible on outside of pump assembly.

7.3.6.2 Laboratory Analysis and Data Validation

Nearly all samples collected by Valley Water are analyzed by Valley Water's water quality laboratory, which is certified under the State of California Environmental Laboratory Accreditation Program. Samples are delivered to the laboratory in the appropriate condition and are accompanied by standard chain-of-custody forms. Samples for metal analyses are filtered and preserved after they are delivered to the laboratory when turbidity is over 1 NTU.

The laboratory commonly performs three types of Quality Control (QC) checks consisting of blank spike, matrix spike, and matrix spike duplicates to determine laboratory precision and accuracy. Precision refers to the closeness of agreement of multiple measurements of the same quantity and accuracy refers to the closeness of a measurement with a known or true quantity. Blank spikes are samples created by adding a known amount of "spike" chemical to a known quantity of laboratory grade de-ionized water. The concentration of the spike sample is therefore known, and results of measurements can be compared against the true amount present in the sample. Matrix spikes are created like blank spikes, but a sample of groundwater from the study area is used instead of de-ionized water. Any interferences resulting from other parameters present in the groundwater "matrix" can be detected. Matrix spike duplicates are run by the laboratory to determine and report analytical precision of measurements conducted on samples with a close resemblance to actual field samples.

In addition to reviewing the laboratory QC results, sampling results are compared to the range of past results. If there are QC issues or the result appears to be an outlier when compared to historic results, the following actions may be taken depending on the specific results and data needs:

- If sufficient sample volume is available, the laboratory may re-analyze the sample.
- The well may be re-sampled.

- If the result is determined to be invalid, it may be discarded and not used in data analysis.
- The results may be retained and used for data analysis.

7.3.6.3 Data Management

Data generated by the various Valley Water monitoring programs are quality assured prior to being stored in the database. The quality assurance (QA) procedure includes verifying that the lab QA/QC meets established standards, that the data is consistent with prior samples from the same well, and where deviations occur, that the data was collected and handled properly. Validated, approved data is transferred to a multi-user Valley Water database that allows for secure storage and 'read-only' privileges for data users. Data that does not meet standard laboratory QA/QC criteria is retained in the database with a flag to indicate data quality issues. Hard copy laboratory reports are scanned into electronic format and placed into an electronic document archival system with key identifiers that allow easy retrieval.

7.4 SURFACE WATER MONITORING

This section describes Valley Water's recharge water quality monitoring and stream-gauging, as well as surface water monitoring efforts by other agencies.

7.4.1 Valley Water Recharge Water Quality Monitoring

The purpose of Valley Water's recharge water quality monitoring is to assess the quality of water used for managed recharge at Valley Water facilities. Recharge facilities (percolation ponds, managed reaches of creeks, etc.) receive local surface water and/or imported water and may be susceptible to contamination from nearby land uses. Valley Water monitors the water quality at its recharge facilities on a rotating three-year schedule, with actual systems sampled depending on availability due to adequate water supplies and maintenance events. This section summarizes current sampling locations, parameters, and monitoring frequency. However, these may be modified in the future in response to changing conditions.

7.4.1.1 Monitoring Locations and Frequency

Recharge water quality monitoring is performed during the dry season to best capture the water quality of water used for managed recharge, with a rotating schedule designed to sample each major recharge system at least once every three years. Monitoring locations are depicted below on Figure 7-13 and 7-14, with the recommended frequency for sampling each recharge system in Table 7-9.

7.4.1.2 Monitoring Parameters

Parameters analyzed by Valley Water for the recharge facilities are shown in Table 7-10. Monitoring parameters were selected based on the program's objective to characterize water quality in the groundwater recharge facilities and to identify parameters that may impact groundwater quality. Parameters monitored include basic water quality parameters, field parameters, and organic compounds.

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Figure 7-13. Location of Valley Water Recharge Water Quality Sampling Locations in the Santa Clara Subbasin

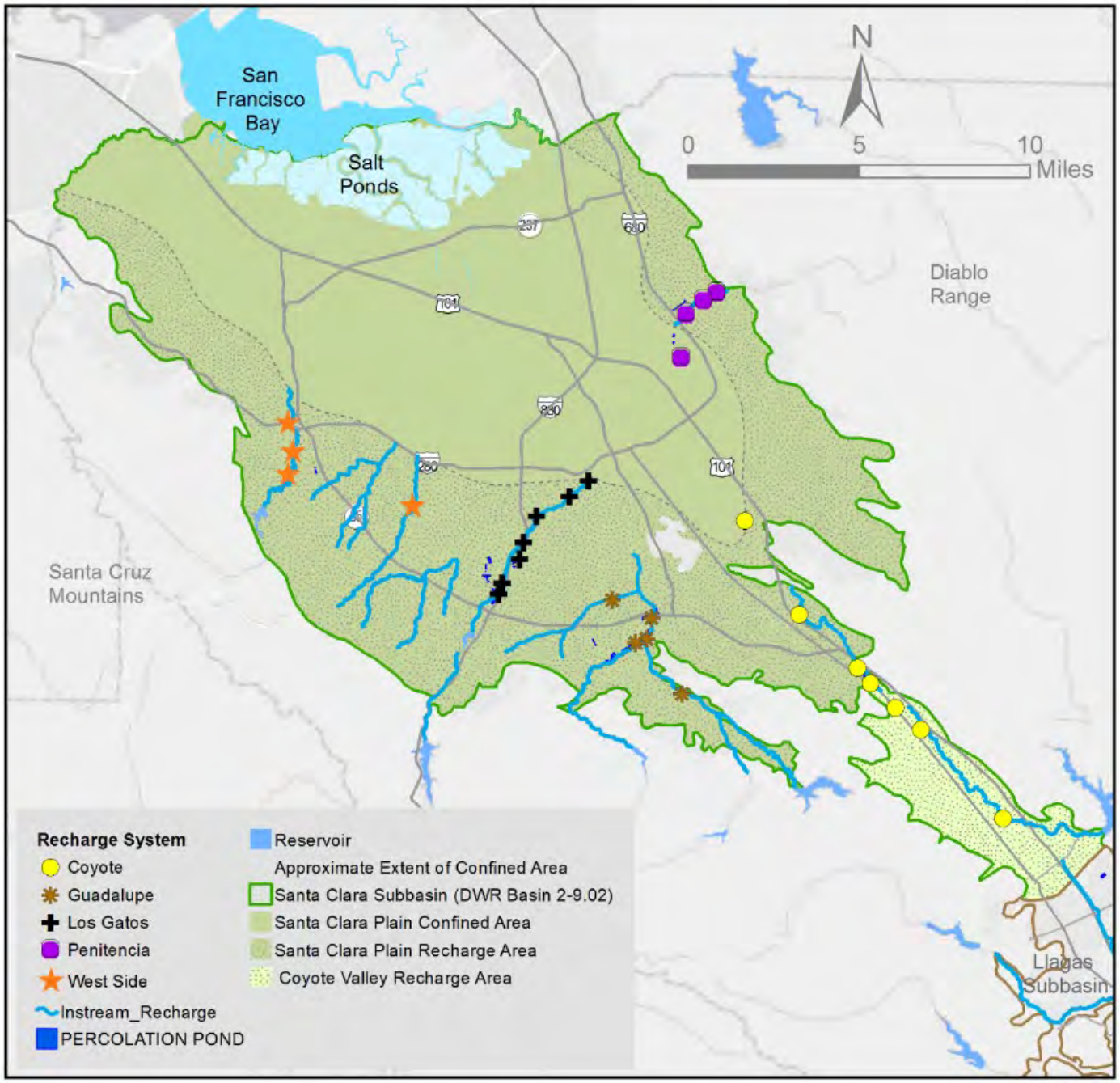

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Figure 7-14. Location of Valley Water Recharge Water Quality Sampling Locations in the Llagas Subbasin

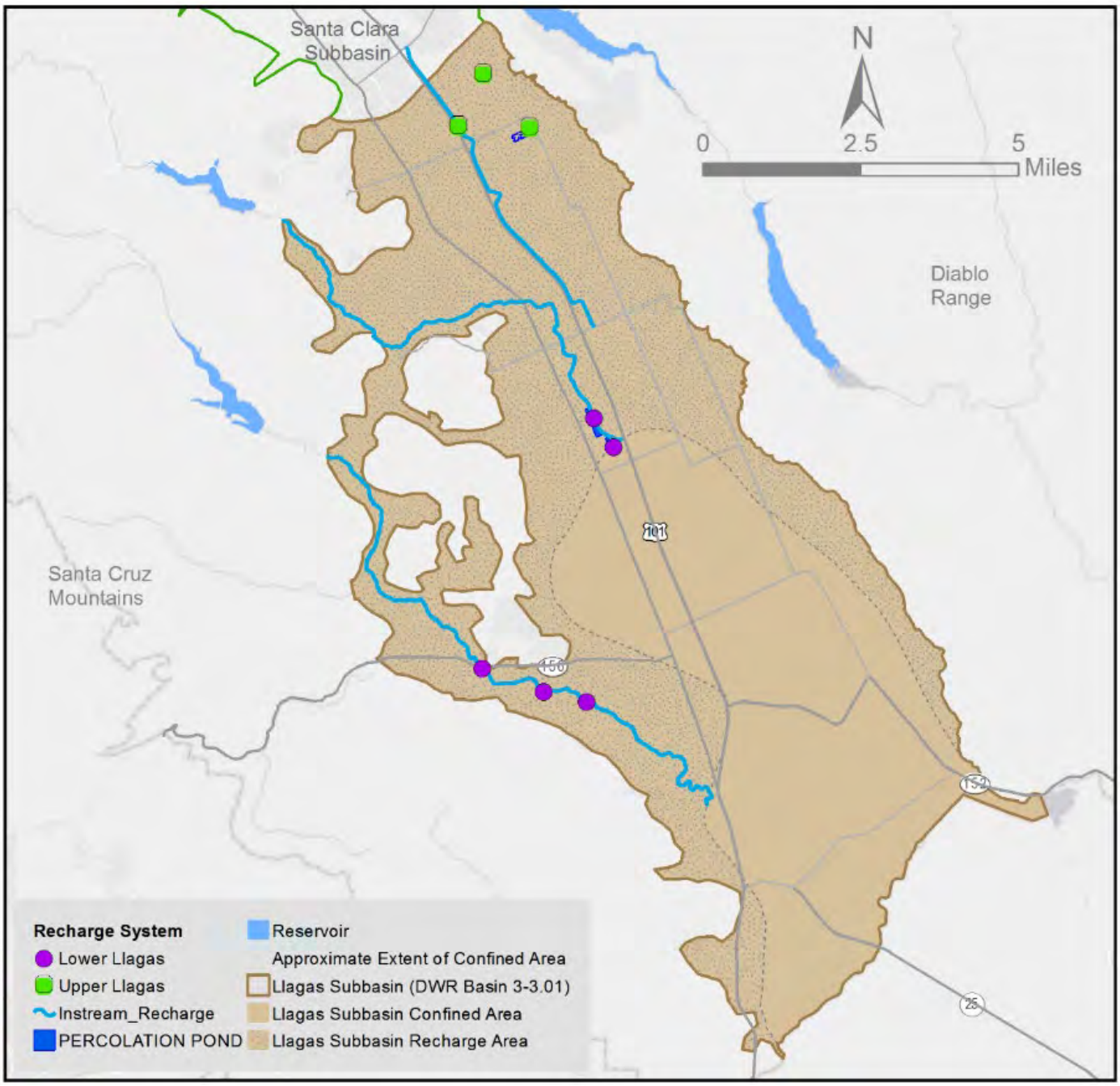

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Table 7-9. Recharge Water Quality Monitoring Schedule

Recharge System	Number of Samples per System	Number of Seasonal Events	Total	2022 and 2025	2023 and 2026	2024 and 2027
Coyote Recharge System	7	2	21		21	
Guadalupe Recharge System	5	2	15			15
Los Gatos Recharge System	7	2	21	21		
Upper Llagas Recharge System	3	2	9	9		
West Side Recharge System	4	2	12		12	
Penitencia Recharge System	4	2	12			12
Lower Llagas Recharge System	5	2	15			15
Total	**35**	**14**	**105**	**30**	**33**	**42**

Table 7-10. Recharge Water Quality Monitoring Parameters

Parameter Type	Parameter	Methods
Basic Water Quality Parameters	Metals and Trace Elements	EPA 200.7/200.8
	Mercury	EPA 245.1
	Inorganics	EPA 300/300.1
	Turbidity	SM2130B
	Alkalinity	SM2320B
	Hardness	SM2340C
	Conductivity	SM2510B
	Total Dissolved Solids	SM2540C
	Chloride	SM4500Cl D
Organic Parameters	Volatile Organic Compounds	EPA 524.2[1]
	Semi-Volatile Organic Compounds	EPA 525.2[1]
Field Parameters	Oxygen	Field
	pH	Field
	Source Temperature	Field
	Specific Conductance-Field	Field
	Turbidity-Field	Field

Notes:
1) Only measured at select sites near higher risk land uses

Basic water quality parameters, including inorganic water quality parameters, allow for determination of recharge water quality at each selected site. Ongoing monitoring helps identify any changes in water quality or potential adverse impacts to groundwater quality. Measured field parameters also help to identify potential changes to groundwater quality from recharge activities.

Some creeks in the Santa Clara County have been identified by the State Water Resources Control Board as impaired

water bodies due to the presence of certain pesticides.[123] Herbicides, pesticides, semi-volatile organic compounds (semi-VOCs) and volatile organic compounds (VOCs) present a greater risk to groundwater contamination at recharge facilities due to high soil permeability.[124] The recharge facilities with the greatest potential for highway, industrial, and commercial facility runoff are monitored for semi-VOCs and VOCs since these are the likely sources for introducing these parameters. However, to date, semi-VOCs and VOCs have not been detected at any recharge facilities where they have been monitored.

7.4.1.3 Monitoring Protocols

Prior to collecting samples, Valley Water measures field parameters including temperature, dissolved oxygen, pH, and electrical conductivity at the water's edge and records related data. For in-stream recharge facilities, the width and depth are also measured and recorded or, if it is not possible to do so safely, these measurements are estimated. Afterwards, samples are collected from the one-foot depth horizon by inverting the sample bottle and submersing it below the surface approximately one foot and then returning the bottle to the upright position, allowing it to fill while minimizing entry of floating debris into the sample container. Prior to filling sample containers, each is tripled rinsed with water from the same recharge facility as that which is being sampled.

If access to the water's edge is difficult, a telescopic pole with a 500-milliliter cup attached to the end is used to collect samples, which are then quickly decanted into the proper sample containers. The cup is inverted as with a regular sample container prior to submersion to obtain a sample from the approximate one-foot depth interval.

7.4.1.4 Recharge Water Quality Data Management

Data generated by this program are first quality assured then transferred electronically to a multi-user database that allows for secure storage and 'read-only' privileges for users. Actual hard copy laboratory reports are scanned into electronic format and placed into a document archival system with key identifiers to allow easy retrieval.

7.4.1.5 Recharge Reporting and Communication

Data from this program reflects the quality of water contained in the raw surface water used for recharge, which is not subject to drinking water standards and may differ considerably from drinking water obtained from wells. Data collected is evaluated and reported in Valley Water's Annual Groundwater Report.

7.4.2 Surface Water Flow Monitoring

Valley Water measures surface water stage and flow rates in streams and channels to ensure that recharge facilities are receiving appropriate flows, to comply with water rights reporting and reservoir restrictions, and to meet environmental requirements. Surface water flow data also helps Valley Water evaluate groundwater interaction with surface water as described in Section 6.3. Real-time and archived stream gauging data is available on Valley Water's website.[125] Stream gauging locations in the Santa Clara and Llagas subbasins are presented in Figures 7-15 and 7-16.

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[123] State Water Resources Control Board, Total Maximum Daily Load Program: California's 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments, www.waterboards.ca.gov.

[124] USEPA, Potential Groundwater Contamination from Intentional and Unintentional Stormwater Infiltration, 1994; and Burton, G. and Pitt, R., Stormwater Effects Handbook, 2002.

[125] Santa Clara Valley Water District, ALERT System Real-Time Data: http://alert.valleywater.org/

Figure 7-15. Santa Clara Subbasin Stream Gauging Locations

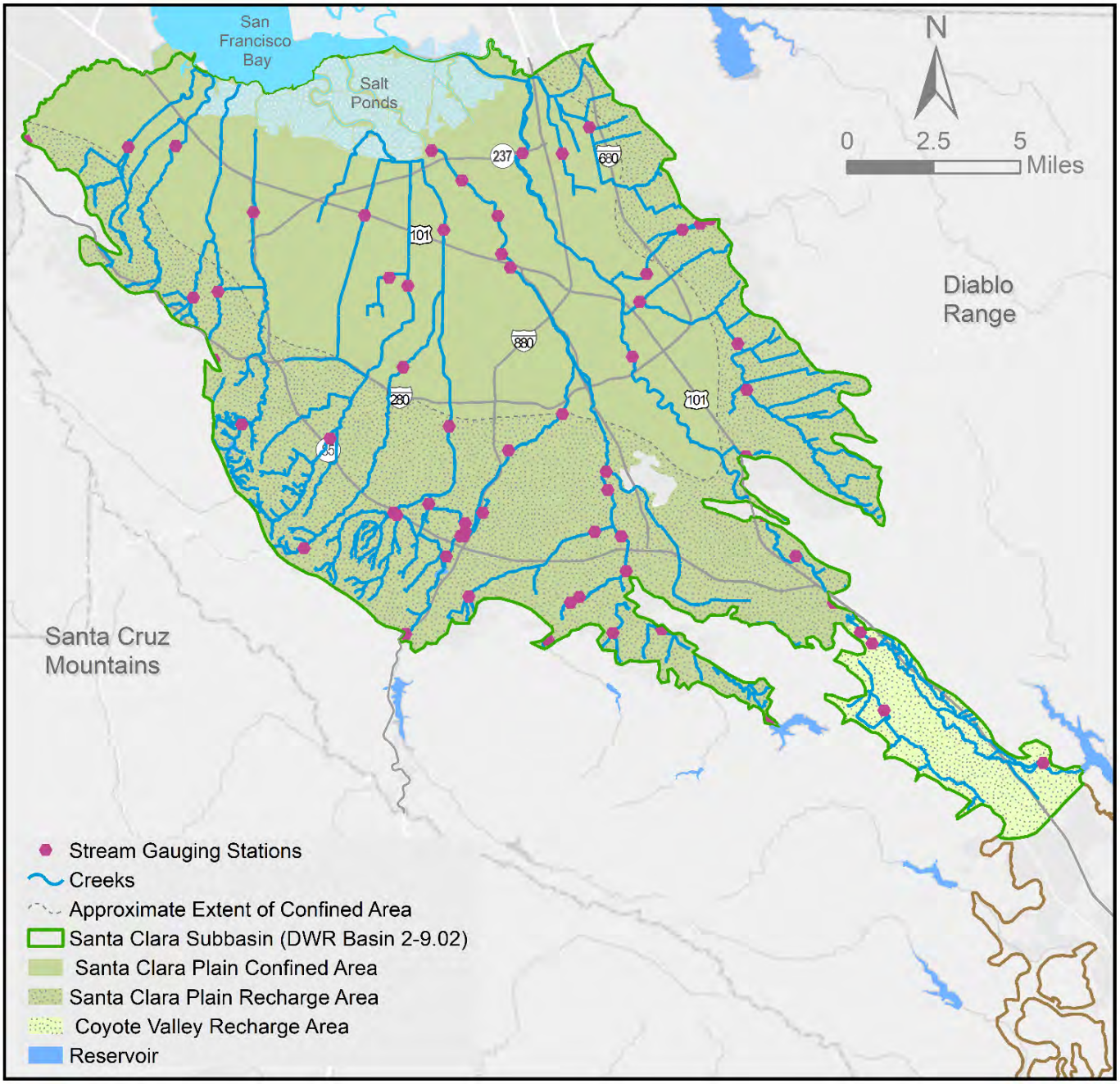

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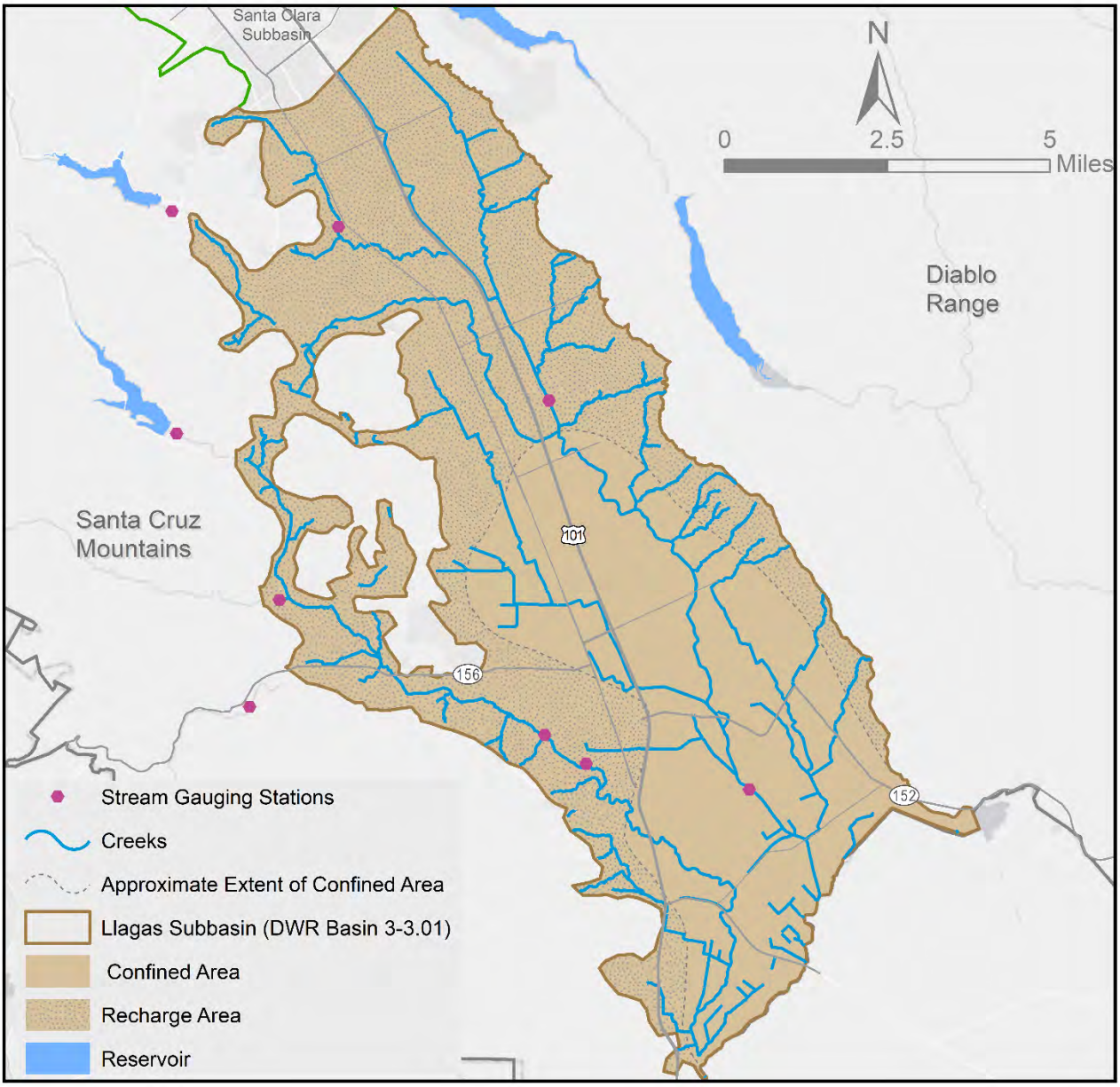
Figure 7-16. Llagas Subbasin Stream Gauging Locations



7.4.3 Surface Water Quality Monitoring by Other Agencies

Other agencies conducting surface water quality monitoring in Santa Clara County include the Central Coast Water Board and SCVURPPP as described below.

7.4.3.1 Central Coast Ambient Monitoring Program

The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast Water Board's regional water quality monitoring program. The CCAMP program aims to collect, assess, and disseminate water quality information to aid decision makers and the public in maintaining and promoting, restoring, and enhancing water quality within the Central Coast region. General programmatic goals of CCAMP are to 1) determine the status and trends of surface,

estuarine and coastal water quality and associated beneficial uses in the Central Coast Region; 2) coordinate with other data collection efforts; and 3) provide information in easily accessible forms to support decision-making.[126]

CCAMP maintains permanent monitoring sites that provide a framework for trend analysis and detection of emerging water quality problems. CCAMP monitors a suite of 33 sites on an ongoing basis and rotates through an additional 30 sites annually in five watershed areas. The program design includes monthly monitoring for standard water quality parameters and flow (where accessible). Other approaches may be used at some sites based on funding and hydrogeomorphological considerations or special interest (such as known discharges or existing Total Maximum Daily Loads (TMDLs)).[127]

7.4.3.2 Santa Clara Valley Urban Runoff Pollution Prevention Program

SCVURPPP is an association of fifteen agencies that share a common permit to discharge stormwater to South San Francisco Bay. Member agencies include the Valley Water, Santa Clara County, and the 13 individual cities in northern Santa Clara County. The permit is granted under the National Pollutant Discharge Elimination System (NPDES) Municipal Regional Stormwater Permit (MRP).

SCVURPPP's goal is to maintain and improve, wherever possible, the quality of stormwater discharged to natural waterways throughout the county. The program's approach to compliance with the terms of the NPDES permit includes pollution prevention, source control (including construction site control), illicit discharge control, municipal operations, water quality monitoring, and outreach. Towards this end, SCVURPPP conducts local water quality monitoring and participates in the San Francisco Bay Regional Water Quality Monitoring Program.

Under the current MRP, water quality monitoring done on behalf of SCVURPPP consists of several components including 1) creek status monitoring 2) more intensive water quality monitoring in locations where past data suggests impaired conditions; 3) monitoring of pollutants of concern (e.g. legacy pollutants such as mercury and polychlorinated biphenyls), and; 4) pesticides and toxicity monitoring. Water quality data collected by SCVURPPP includes a collection of creek health indicators including aquatic insects, algae, bacteria, physical habitat, sediment chemistry, and basic water quality parameters such as dissolved oxygen, temperature, etc. The MRP is due to be reissued in July, 2022. It's provisions for water quality monitoring will change substantially with respect to type and quantity. Water quality data collected by SCVURPPP are stored in the California Environmental Data Exchange Network database. Results are presented each year in an annual report.[128]

Between 2012 and 2021, the SCVURPPP Water Quality Monitoring and Watershed Assessment Program collected and analyzed water quality monitoring data from 212 creek sites located within 10 of the 13 major Santa Clara Basin watersheds. Water samples were analyzed for conventional water quality parameters, chemical pollutants (metals and organic contaminants), aquatic toxicity, and pathogen indicators. The SCVURPPP Water Quality Program is conducted to achieve specific objectives and is not carried out continuously. Additional creek monitoring efforts are planned, with updates available on the SCVURPPP website.[129]

7.5 REPORTING AND DATA AVAILABILITY

Monitoring data provides the basis for numerous Valley Water programs, projects, and management decisions, including annual water supply operations and long-term water utility planning. Data collected by Valley Water is

[126] Regional Workplan, Five Year Workplan 2012-2017: https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/workplans/r3_5yr_wrkpln.pdf
[127] Central Coast Ambient Monitoring Program: http://www.ccamp.org/ccamp/ccampa3.htm
[128] Most recent SCVURPPP Annual Report: https://scvurppp.org/2020/09/30/fy-19-20-annual-report/
[129] Santa Clara Valley Urban Runoff Pollution Prevention Program: https://scvurppp.org/

made publicly available on Valley Water's website[130] through several regular publications as shown in Table 7-11 below. Water level data is also available on-line at https://gis.valleywater.org/GroundwaterElevations/

Table 7-11. Groundwater Reports

Report	Frequency of Publication	Contents
Water Tracker	Monthly	Overview of current water supply conditions, including high-level summary of groundwater levels, estimated pumping and managed recharge.
Monthly Groundwater Condition Report	Monthly	More detailed information on current groundwater levels, estimated pumping, and managed recharge to supplement the monthly Water Tracker.
Protection and Augmentation of Water Supplies (PAWS) Report	Annual (February)	Information on water supply and use; groundwater recharge, pumping, levels, and storage; in-lieu recharge, projected water supply availability and demand, and activities to protect and augment water supplies as required by the District Act.
Annual Groundwater Report and Groundwater Quality Summary	Annual (July)	Detailed information on conditions in the Santa Clara and Llagas subbasins for the preceding calendar year, including groundwater levels, pumping, and recharge, subsidence, and groundwater monitoring results. The 2019 Annual Groundwater Report is included in Appendix E.
Annual Groundwater Summary Report	Annual	Summarized information on groundwater quality conditions in Santa Clara and Llagas subbasins for the preceding calendar year, focusing on parameters with primary and secondary MCLs. The 2019 Annual Groundwater Summary Report is included as an Appendix within the 2019 Annual Groundwater Report.
Water Year Report	Annual (April 1)	Annual report submitted to DWR by April 1 of each year following the adoption of the Alternative Plan, as required under California Code of Regulations Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 7, §356.2. This report summarizes information on groundwater conditions and management, included groundwater level elevation data, water supply and use (groundwater extraction, surface water supply used, total water use, and change in groundwater storage), and plan implementation.

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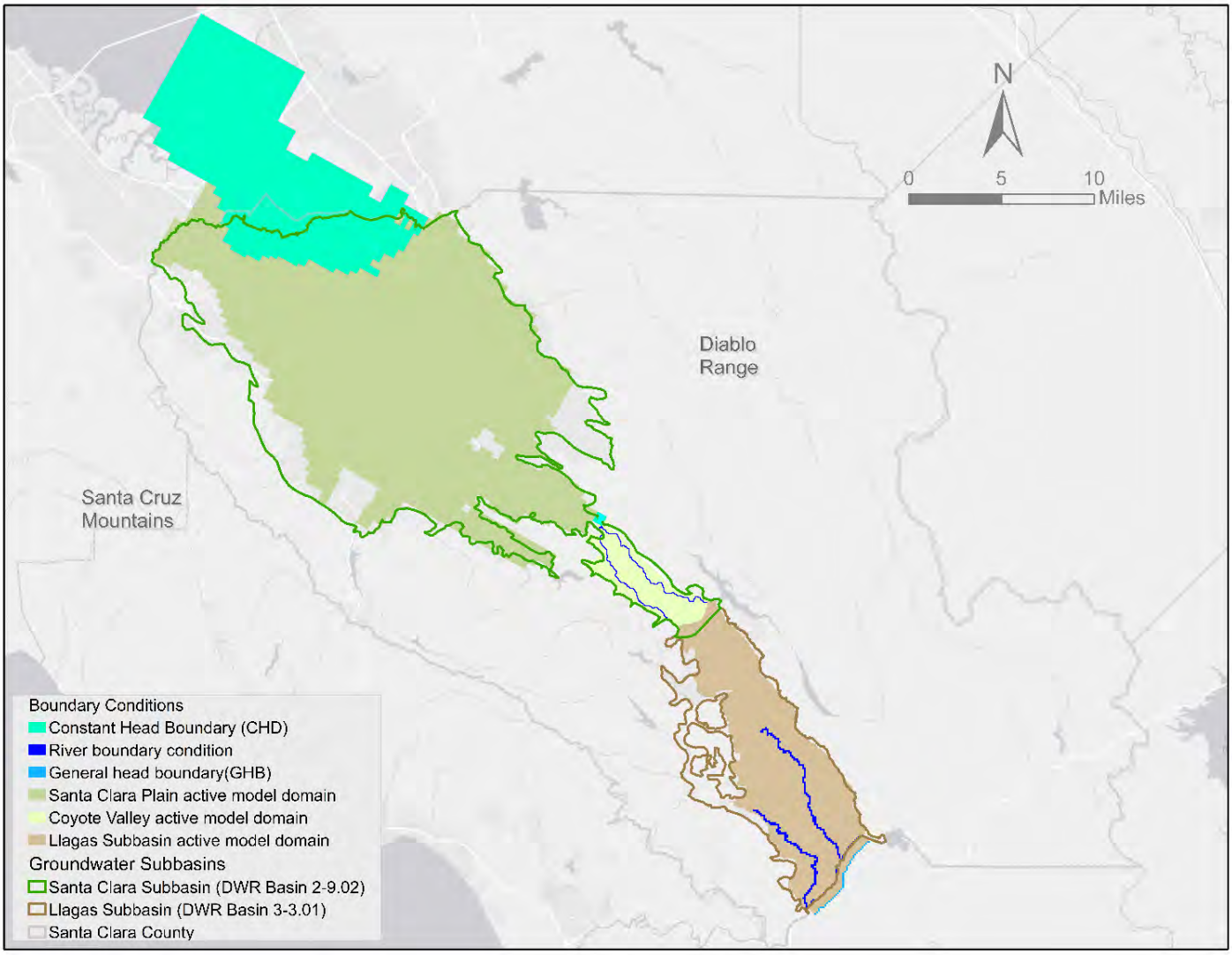
[130] http://www.valleywater.org

7.6 GROUNDWATER MODELS

Valley Water uses numerical models to support operational decisions and long-term water supply planning. These include operational and water supply system models as well as groundwater flow models, which are described in this section. Currently, Valley Water maintains three numerical groundwater models: two for the Santa Clara Subbasin (one for the Santa Clara Plain and one for Coyote Valley) and a separate model for the Llagas Subbasin (Figure 7-17). These models are used to evaluate and forecast groundwater storage and water levels under various operational and hydrologic conditions. Maintaining calibrated models that can reasonably forecast groundwater conditions is an important part of Valley Water's comprehensive groundwater management strategy.

Figure 7-17. Groundwater Flow Model Domain and Boundary Conditions



7.6.1 Santa Clara Subbasin Models

Valley Water uses and maintains two numerical groundwater models for the Santa Clara Subbasin: one for Santa Clara Plain and the other for Coyote Valley, as described below.

7.6.1.1 Santa Clara Plain Model

The Santa Clara Plain Model is a numerical groundwater flow model for the northern Santa Clara Valley.[131] The numerical model is based on the hydrogeologic conceptual model presented in the Hydrogeologic Interpretation Draft Technical Memorandum.[132] The Santa Clara Plain model uses the MODFLOW model[133] to simulate groundwater flow in the Santa Clara Plain, with the model domain (Figure 7-17) extending from the Coyote Narrows (Metcalf Road) in the south to the Santa Clara-Alameda and Santa Clara-San Mateo county lines in the north. The model area encompasses most of the alluvial fill in the northern Santa Clara Valley.

The Santa Clara Plain model comprises six layers. Layers 1 and 2 represent shallow aquifers above the regional confining layer and extend only to the confined area boundary. Layer 3 extends over the entire model domain, representing the principal aquifer under the confining layer in the center of the basin and the shallow aquifer in the unconfined area for the remainder of the domain. Layers 4, 5, and 6 represent the deeper zones of the principal aquifer, which vary in extent based on the shape of the basin and bedrock encountered at depth. The model grid contains 57 rows and 92 columns. Active grid cells encompass an area of approximately 315 square miles. The smallest cells have a grid spacing of 1,000 feet by 1,000 feet and the largest cells have a grid spacing of 6,000 feet by 6,000 feet. Horizontal flow boundaries include constant head and no-flow boundaries. Constant head cells are assigned to model cells that simulate San Francisco Bay and the Coyote Narrows. All other horizontal model boundaries are represented by no-flow cells.

The model uses data from 1970 to present, with a monthly stress period. The model has two major inflow components: managed recharge and natural recharge. The managed recharge occurs through nineteen percolation facilities. Natural recharge includes deep percolation of rainfall, minor un-gauged percolation from streams, mountain front recharge, water loss from transmission and distribution lines, sewer line exfiltration, and return water from agricultural and all other pumping. A constant head boundary condition at the Coyote Narrows simulates the subsurface groundwater exchange between the Coyote Valley and the Santa Clara Plain. The major outflow component is groundwater pumping. Minor outflow components accounted for in the model include evapotranspiration, sewer infiltration, and subsurface flow to San Francisco Bay (shallow layers) and aquifers beneath San Francisco Bay (deeper layers) through a constant head boundary. The initial head distribution is generated based on water level data measured during late 1969 and early 1970. The model is updated or improved when additional data becomes available.

7.6.1.2 Coyote Valley Model

In 2000, CH2M Hill developed a finite element Coyote valley groundwater model using Microfem for the Metcalf Energy Center.[134] CH2M Hill transformed the Microfem finite element model into a finite difference grid using data from mid-1987 through 1998 in six-month increments and provided the finite difference grid model to Valley Water. Valley Water staff made significant modifications to the CH2M Hill finite difference grid model and uses the refined model to assess groundwater conditions in the Coyote Valley.

The Coyote Valley model boundary (Figure 7-17) extends from Metcalf Road at the Coyote Narrows in the north to the groundwater divide near Cochrane Road (Morgan Hill) in the south. The eastern and western boundaries are the contact between the valley fill alluvial sediments and the bedrock exposed along the edge of the valley. The finite difference model grid contains 140 rows and 150 columns, with a uniform grid spacing of 250 feet by 250 feet. The model runs on both MODFLOW 88/96 and MODFLOW 2000 using data from mid-1987 to present and a monthly

[131] CH2M HILL, Santa Clara Valley Groundwater Model Project, Basinwide Groundwater Flow Model, 1992a.
[132] CH2M HILL, Santa Clara Valley Groundwater Model Project, Hydrogeologic Interpretation, 1992b.
[133] McDonald and Harbaugh, A modular three-dimensional finite-difference ground-water flow model ,1988.
[134] CH2M Hill, Coyote Valley Groundwater Report, 2000.

time step. The model consists of four layers: three top layers representing alluvial sediments and the bottom layer representing the Santa Clara formation. The top alluvium is divided into three model layers of equal thickness to enable greater flexibility in assigning pumping and water level changes to discrete intervals or different depths within the model.

The inflow water budget components are managed recharge through Coyote Creek, areal recharge from the deep percolation of rainfall and agricultural irrigation/septic system return flows and stream seepage from upper Fisher Creek. Areal recharge at the top surface of the model is simulated using the MODFLOW Recharge package. Groundwater-surface water interactions along Coyote and Fisher creeks are simulated with stage data by the MODFLOW River package. A time-variant constant head boundary condition using the MODFLOW Constant Head package is defined at the Coyote Narrows in the north to simulate the subsurface groundwater exchange between the Coyote Valley and the Santa Clara Plain. The model has no-flow boundary conditions on the east, west, and south boundaries and bottom of the model. The outflow water budget components are groundwater pumping, subsurface outflows at the Coyote Narrows, evapotranspiration from shallow groundwater areas, and gaining reaches of Fisher and Coyote creeks. Groundwater extraction from model layers 2 and 3 is simulated using the MODFLOW well package. Evapotranspiration from shallow groundwater areas is simulated using the MODFLOW Evapotranspiration package.

7.6.2 Llagas Subbasin Model

The Llagas Subbasin groundwater flow model was developed in 2005 to provide Valley Water with a tool to support management of the subbasin.[135] The model is used to evaluate groundwater supplies using current and future demands under different managed recharge operations and hydrologic conditions.

The Llagas model was developed with a finite difference gridding method using MODFLOW 2000 to assess the subbasin response to groundwater demand, managed recharge operations and hydrologic conditions using data from the water year 1988 to water year 2002 in six-month increments. The model currently used by Valley Water is a revised version of the original model that runs from October 1987 to the present in one-month increments. The model grid (Figure 7-17) covers the main alluvial areas of the Llagas Subbasin, which extends from Cochrane Road in the north to the subbasin's southern boundary near the Pajaro River. The finite difference grid contains four active layers of 200 rows and 140 columns, with a uniform grid spacing of 500 feet by 500 feet. The model has four parallel layers that roughly coincide with the distribution of production well perforations. The bottom of Layer 1 is below the lowest water levels anticipated during simulations, and the bottom of Layer 4 is the top of the bedrock interpreted from cross-sections. The elevation and thickness of the layers are based on borehole lithology and drillers logs.

The Llagas model inflow water budget components are managed recharge to creeks and percolation ponds, natural recharge (estimated as the deep percolation of rainfall, septic return flow, and stream seepage), and subsurface inflow (from bedrock uplands, alluvial tributary canyons, and the adjacent Bolsa Subbasin). The outflow components are mainly groundwater pumping, with smaller fractions of evapotranspiration, gaining creeks, and subsurface outflows to the Bolsa subbasin. The inflow and outflow water budget components are simulated in the model using different MODFLOW 2000 packages. The Llagas model has no-flow boundaries on the east and west sides of the model, at Cochrane Road in the north, and at the bottom of layer 4. A general head boundary is set at the southern boundary to simulate the head-dependent subbasin exchange between the Llagas and Bolsa Subbasins. The top surface of the model is simulated using MODFLOW recharge, well (injection), evapotranspiration, and river packages. Extraction wells are simulated using the well package from layer 1 through 4 depending on well perforation.

[135] CH2MHill, Llagas Basin Numerical Groundwater Model Report, 2005

7.6.3 Groundwater Storage Analysis

Groundwater provides nearly all water used in the Coyote Valley and Llagas Subbasin and is an important water supply in the Santa Clara Plain. Valley Water regularly analyzes groundwater storage to support operational decisions, contingency planning, and planning to meet future needs. To support near-term operations, Valley Water uses groundwater models to estimate storage for the current year and simulate conditions for the following calendar year under a range of projected water supply and hydrologic scenarios. As the water year progresses and more water supply and demand information become available, operations plans are updated accordingly. The goal of operations planning is to ensure adequate supplies are available and groundwater resources are protected. Projected end of year groundwater storage is used to evaluate the storage outcome measure (Chapter 5) and is the key trigger for Valley Water's Water Shortage Contingency Plan, which recommends increased short-term water use reduction measures as groundwater storage declines.

Groundwater models are also used to support long-term water planning efforts such as the Urban Water Management Plan and Water Supply Master Plan and individual projects. Understanding groundwater conditions under various pumping and hydrologic scenarios supports the analysis of the potential impacts of various projects, or when and where additional investments (such as additional recharge) may be needed.

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Chapter 8 – Next Steps

CHAPTER 8 – NEXT STEPS

Previous chapters of this 2021 Groundwater Management Plan outline Valley Water's basin sustainability goals, strategies to meet those goals, related programs and activities, and outcome measures to gauge performance. This chapter describes outcome measure evaluation, potential tools to address outcome measure performance, and recommendations to ensure continued sustainability.

8.1 EVALUATION AND REPORTING OF OUTCOME MEASURES

The 2021 GWMP is based on an adaptive groundwater management philosophy that is consistent with SGMA and uses a "Plan, Do, Check, Act" framework or model of continuous improvement:

- Identify sustainability goals and strategies in accordance with the District Act, Board policy, and SGMA ("Plan")
- Implement basin management programs and activities in accordance with strategies to achieve sustainability goals ("Do")
- Conduct monitoring, analyze results, and compare to outcome measures and corresponding outcome measure-lower thresholds ("Check")
- Modify existing programs or evaluate and develop new strategies and tools if outcome measures and outcome measure-lower thresholds indicate improvement is needed ("Act")

The outcome measures and corresponding outcome measure-lower thresholds presented in the 2021 GWMP will be evaluated on an annual basis and presented in the Annual SGMA Water Year Reports and Valley Water's Annual Groundwater Report, which will also include recommendations for action as needed. Valley Water will review and update the GWMP as needed, but at least every five years. This will ensure compliance with SGMA requirements for GSP Alternatives and provide current groundwater management information to support five-year updates of the Urban Water Management Plan as required by State law.

8.2 ADDRESSING OUTCOME MEASURE PERFORMANCE

Significant investments in conjunctive water management, close coordination with water retailers, and careful planning have allowed Valley Water to overcome historical undesirable results related to long-term overdraft, subsidence, and seawater intrusion to achieve sustainable groundwater conditions. Valley Water's approach to groundwater management has evolved over many decades in response to numerous challenges, and this adaptive approach will help meet future water supply challenges to ensure continued groundwater sustainability.

If evaluation of the outcome measures and outcome measure-lower thresholds indicates a need for improvement, Valley Water will first assess potential changes to existing programs and activities prior to considering significant groundwater management changes. Any significant policy or investment decisions would be developed and evaluated in coordination with other Valley Water planning efforts and in consultation with water retailers and local stakeholders, as Valley Water does in current planning and budgeting processes.

8.2.1 Groundwater Supply Reliability

Maintaining reliable groundwater supplies helps meet community water needs and avoid undesirable results such as long-term overdraft, land subsidence, and seawater intrusion. The 2020 UWMP projects that countywide water supplies are generally sufficient to meet demands through 2045 under a normal, a single dry, and a five consecutive dry year conditions.[136] The greatest challenge to Valley Water's water supply reliability is multiple year

[136] Santa Clara Valley Water District, Urban Water Management Plan, 2020.

droughts, such as the 2012–2016 drought and current prolonged drought conditions. In response to the current drought, Valley Water is calling for a mandatory water-use reduction of 15% relative to 2019, conducting a comprehensive campaign to increase the community's awareness and participation in water conservation, working with water retailers on water source shifts, taking deliveries of water from Semitropic Water Bank, and securing emergency imported water supplies, among other actions.

Adopted in 2019, Valley Water's WSMP 2040 outlines three strategy elements to provide a reliable supply of water to meet countywide needs through 2040. The elements include securing existing supplies and infrastructure, increasing water conservation and water reuse, and optimizing the use of existing supplies and infrastructure. The strategy elements ensure sustainability because they maintain and build on existing baseline system, develop drought-resistant supplies to meet drought needs, and manage risks to water supply reliability from climate change and other risks and uncertainties. The WSMP 2040 recommend a diverse water supply portfolio that will benefit groundwater supply reliability, including water conservation and stormwater projects. The WSMP 2040 also includes developing at least 24,000 AFY of additional recycled water by 2040. This target will be achieved by implementing the planned Indirect Potable Reuse Project, which includes using purified water for groundwater recharge at the existing Los Gatos recharge system.

In addition to those projects and actions outlined in the 2020 UWMP and WSMP 2040, Valley Water's other existing groundwater management tools for ensuring groundwater reliability include:

- Implementation of managed recharge and groundwater pumping offsets through in-lieu recharge programs.
- Cooperation with water retailers on source shifts and shortage response.
- Creation of new or modified groundwater benefit zones beyond recent changes made in 2020[137].
- Coordination with water retailers and land use agencies on General Plans, Urban Water Management Plans, and water supply assessments.

Potential groundwater management activities and tools that Valley Water could also consider if needed to ensure sustainable groundwater supplies include:

- Changes to the groundwater charge rate structure.
- Changes in Valley Water's well permitting and well metering processes.
- Institutional agreements with water retailers related to groundwater management.
- Regulation of groundwater pumping under Board Resolution 18-04 (Appendix F), if needed. As noted in the resolution and Chapter 1, continued collaboration with water retailers and other pumpers is the preferred approach to addressing future challenges.

8.2.2 Groundwater Quality Protection

Challenges to protecting groundwater quality include intensified land use, emerging contaminants such as PFAS, and more stringent regulatory standards. Valley Water does not control land use or deliver groundwater directly to customers, so protecting groundwater quality requires coordination with water retailers, land use agencies, regulatory agencies, and the public.

Valley Water's existing groundwater management tools to protect groundwater quality include:

[137] https://www.valleywater.org/your-water/where-your-water-comes/groundwater/groundwater-benefit-zone-study

- Coordination with regulatory agencies to address threats such as PFAS and ensure adequate cleanup at high-threat remediation sites.
- Coordination with local land use agencies on water supply assessments, land use proposals, stormwater infiltration devices, septic systems, and small water systems served by wells.
- Outreach to domestic well owners on well maintenance and water quality issues, such as nitrate.

Potential groundwater management activities and tools that Valley Water could also consider if necessary to improve groundwater protection include:

- Increased coordination with regulatory agencies to ensure high-threat contamination is promptly and adequately addressed.
- Expanded outreach efforts to raise awareness of groundwater protection, including outreach to agricultural users in coordination with local partners and the Central Coast Water Board.
- Coordination with local land use agencies and others to develop guidelines or best management practices related to specific threats.
- Expanded efforts with legislators and others to target significant threats and fund regulatory efforts.
- Enhanced managed recharge programs to further dilute contaminants.
- Re-initiation of Valley Water's abandoned well destruction assistance program to address vertical conduit threats.
- New groundwater protection ordinance or regulatory solutions, if needed to protect groundwater quality.

8.3 GROUNDWATER MANAGEMENT PLAN RECOMMENDATIONS

Valley Water's proactive groundwater management programs and activities have maintained sustainable groundwater levels and storage, minimized land subsidence, and improved groundwater protection. To maintain the long-term sustainability of groundwater resources, the following actions are recommended, with many of these carried forward from 2016 as they are still essential and relevant:

1. **Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.**

   Programs to recharge groundwater through direct replenishment and in-lieu recharge maintain groundwater levels and flow gradients and are essential to prevent groundwater overdraft, land subsidence, and seawater intrusion. Priorities include efforts to:

   a. Ensure the reliability of Valley Water's water utility infrastructure, including local dams and reservoirs, diversion structures, pipelines, pumping stations, treatment plants, and managed recharge facilities through appropriate maintenance or replacement.

   b. Implement high-priority capital projects that support conjunctive water management, including indirect potable reuse, which provides a drought-resilient, locally controlled recharge source, and dam seismic retrofit projects, which will restore full reservoir capacity to better source managed and in-lieu recharge.

   c. Secure local and imported sources of supply, including a long-term solution for reliable Delta conveyance.

d. Maintain and expand in-lieu recharge programs to offset pumping, including treated water sales, water recycling and water conservation, to reduce demands on the groundwater subbasins.

e. Encourage water retailers to maintain other water supply sources, including San Francisco Public Utilities Commission contract deliveries to Santa Clara County.

f. Maintain and optimize operations activities that support conjunctive water management, including modeling, forecasting, systems control, and water accounting. For example, update and refine the recharge capacity of the managed recharge facilities.

2. Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.

A reliable water supply depends not only on quantity, but also on quality. Unlike surface water, most groundwater pumped in the county does not require treatment beyond disinfection, making protection of this local resource all the more important. Priorities include efforts to:

a. Continue to implement comprehensive programs to evaluate groundwater quality conditions so potentially adverse trends can be quickly identified and appropriate action can be taken before conditions become severe.

b. Continue to track the threat PFAS and other emerging contaminants pose to local groundwater resources and work with water retailers, regulatory agencies, and other stakeholders to take actions needed to protect water supplies.

c. Collaborate with local partners and regulatory agencies on efforts including salt and nutrient management, stormwater management, land use and policy review, recycled water expansion, and sea-level rise impacts to protect groundwater quality.

d. Evaluate opportunities for expanded partnerships to maximize groundwater protection.

3. Continue to incorporate groundwater sustainability in Valley Water planning efforts.

Future sustainability depends on continued, thoughtful water supply planning and investments. Priorities include efforts to:

a. Continue implementing the Water Supply Master Plan 2040 to address future challenges to maintain reliable groundwater supplies and implement related projects as appropriate. For example, continue the partnership between Valley Water and U.C. Water to complete the pre-feasibility study of potential flood managed aquifer recharge (Flood-MAR) in the Santa Clara and Llagas subbasins.

b. Continue including groundwater sustainability as an important component under Valley Water's long range water supply plans, including the WSMP, UWMP, and related WSCP.

c. Account for groundwater sustainability during the planning and implementation of multi-benefit projects under Valley Water's One Water Plan.

4. Maintain adequate monitoring programs and modeling tools.

The assessment of groundwater conditions and performance of outcome measures relies on timely, accurate, and representative data. Valley Water has comprehensive groundwater monitoring programs and calibrated groundwater flow models, but they need to be maintained and improved. Priorities include efforts to:

a. Acquire and/or install new monitoring wells to address gaps in existing monitoring networks, as outlined in Appendix J, and continue to regularly evaluate monitoring networks to address gaps, redundancies, and changing needs.

b. Continue to identify and implement modeling improvements to enhance simulation capabilities, including groundwater storage estimates and sea-level rise impacts on seawater intrusion.

c. Continue to improve understanding of surface water/groundwater interaction. Expand on Valley Water's 2018 differential gauging study to include additional time periods, hydrologic conditions, and methods, as appropriate.

d. Evaluate the subsidence thresholds at index wells under present-day groundwater conditions for continued protection against resuming inelastic (permanent) subsidence in the Santa Clara Subbasin. Evaluate the relationship between short-term declines in groundwater levels at index wells and the response between elastic (temporary) versus inelastic (permanent) subsidence (Appendix J).

e. As outlined in Appendix G, revise and update the groundwater dependent ecosystem (GDE) maps as new information becomes available during each five-year GWMP update cycle.

5. Continue and enhance groundwater management partnerships with water retailers and land use agencies.

Continued collaboration and strong partnerships with water retailers and land use agencies are needed to ensure future sustainability, with priorities including efforts to:

a. Continue regular interaction with water retailers through Water Retailer meetings, including the Groundwater Subcommittee.

b. Meet regularly with South County water retailers to discuss groundwater management issues in areas dependent on groundwater.

c. Explore options for improved management of local water and San Francisco Public Utilities Commission supplies in Santa Clara County.

d. Maintain contingency plans and further develop management options for water shortages, as well as for local or Delta-related interruptions in supply.

e. Coordinate with water retailers and local land use agencies on General Plans, water supply assessments, and Urban Water Management Plans.

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Glossary

A

Acre-Foot
The volume of water necessary to cover one acre to a depth of one foot; equal to 43,560 cubic feet or 325,851 gallons.

Alluvium
A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream or other body of running water, as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, as a cone or fan at the base of a mountain slope.

Aquifer
A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs.

Aquitard
A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores ground water.

Artesian Aquifer
A body of rock or sediment containing groundwater that is under greater than hydrostatic pressure; that is, a confined aquifer. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer.

B

Basin
A groundwater basin or subbasin identified and defined in the California Department of Water Resources Bulletin 118.

Basin Plan
The Regional Water Quality Control Board's master water quality control planning document that designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater and includes implementation programs to achieve water quality objectives.

Beneficial Use
One of many ways that water can be used either directly by people or for their overall benefit. The State Water Resources Control Board recognizes 23 types of beneficial use with water quality criteria for those uses established by the Regional Water Quality Control Boards.

Bulletin 118
The Department of Water Resources report, entitled "California's Groundwater: Bulletin 118", updated in 2003, or as it may be subsequently updated or revised.

C

CASGEM
The California Statewide Groundwater Elevation Monitoring Program developed by the Department of Water Resources pursuant to Water Code Section 10920 et seq.

Cone of Depression
In an unconfined aquifer, this is an actual depression of the water levels. In confined aquifers (artesian), the cone of depression is a reduction in the pressure head surrounding the pumped well.

Confined Aquifer
An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself. An aquifer containing confined groundwater. See artesian aquifer.

Conjunctive Management/Use
The coordinated and planned management of both surface and groundwater resources to maximize the efficient use of the resource; that is, the planned and managed operation of a groundwater basin and a surface water storage system combined through a coordinated conveyance infrastructure. Water is stored in the groundwater basin for later and planned use by intentionally recharging the basin with available surface water supplies.

G

General Circulation Model (or global climate model)
Numerical models representing physical processes in the atmosphere, ocean, cryosphere and land surface, are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations.

Groundwater
Water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water but does not include water that flows in known and definite channels.

Groundwater Basin
An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.

Groundwater Budget
A numerical accounting of the recharge, discharge and changes in storage of an aquifer, part of an aquifer, or a system of aquifers. The groundwater equation for mass conservation or balance for an aquifer, part of an aquifer, or a system of aquifers.

Groundwater Charge Zone
A zone in which groundwater production charges are levied to fund District activities that protect and augment groundwater supplies.

Groundwater Demand
The quantity of groundwater within the subbasin needed for beneficial use.

Groundwater Dependent Ecosystem
An ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

Groundwater Gradient
A measure of the change in groundwater head over a given distance. Groundwater flows from areas of high hydraulic head (high water level elevation) to areas of low head (low water level elevation).

Groundwater Recharge
The natural or intentional infiltration of surface water into the zone of saturation.

Groundwater Subbasin
A subdivision of a groundwater basin created by dividing the basin using geologic and hydrologic conditions or institutional boundaries.

Groundwater Sustainability Agency
One or more local agencies that implement the provisions of the Sustainable Groundwater Management Act. The

Santa Clara Valley Water District is the groundwater sustainability agency for Santa Clara Subbasin and Llagas Subbasin.

Groundwater Sustainability Plan (GSP)
A plan of a groundwater sustainability agency proposed or adopted pursuant to the Sustainable Groundwater Management Act.

I

Imported Water
Non-local source of water. Water is purchased from the State and Federal Water Projects and others outside the groundwater basin's geographical boundaries and transported into the basin for use as surface water or for recharge into the basin.

In-Lieu Recharge
The practice of providing surplus surface water or recycled water to historic groundwater users, thereby leaving groundwater in storage for later use. Water conservation programs also serve as in-lieu recharge by reducing demands, thereby increasing storage.

L

Land Subsidence
The lowering of the natural land surface due to groundwater extraction.

Long-Term Overdraft
The condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus. Overdraft during a period of drought is not sufficient to establish a condition of long-term overdraft if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

M

Managed Recharge
The addition of water to a groundwater reservoir by human activity, such as putting surface water into dug or constructed spreading basins or injecting water through wells.

Maximum Contaminant Level (MCL)
The highest drinking water contaminant concentration allowed under federal and State Safe Drinking Water Act regulations. Health based MCLs are referred to as Primary MCLS. Secondary MCLs are established for contaminants that may affect aesthetic properties of drinking water such as taste, color, and odor.

N

Natural Recharge
Natural replenishment of an aquifer, generally from runoff, through seepage from the surface.

O

Operational Storage
The usable storage within an aquifer system or groundwater basin that accounts for the avoidance of adverse impacts. It is a dynamic quantity that must be determined from a set of alternative groundwater management decisions subject to goals, objectives, and constraints of the groundwater management plan.

Outcome Measures
Specific, quantifiable goals for the maintenance or improvement of the specified groundwater conditions included in the Plan to achieve the sustainability goal for the basin.

P

Potable Reuse
The use of recycled water as part of the potable water supply. Indirect potable reuse is the use of highly treated recycled water for managed recharge, which provides natural filtration and blending with groundwater prior to its reuse as a potable supply. Direct potable reuse is the direct delivery of highly purified recycled water to the potable water supply.

Public Water System
As defined in Section 116275 of the Health and Safety Code, a public water system is a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following:

(1) Any collection, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system.

(2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system.

(3) Any water system that treats water on behalf of one or more public water systems for rendering it safe for human consumption.

R

Recharge Area
The area that supplies water to an aquifer in a groundwater basin.

Representative Concentration Pathway
A greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). Four pathways were used for climate modeling for the IPCC fifth Assessment Report (AR5) (RCPs 2.6, 4.5, 6, and 8.5). The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases emitted in the future. RCP 8.5 was used in this 2021 GWMP and refers to a radiative forcing value of 8.5 W/m^2. RCP 8.5 is generally taken as the basis for the worst-case climate change scenarios.

S

Salt Water Intrusion
The movement of salt water into a body of fresh water. It can occur in either surface water or groundwater bodies.

Semitropic Groundwater Bank
Long-term water storage project designed to optimize the distribution and use of water resources between the Semitropic Groundwater Bank and its banking partners, like the District. Semitropic receives SWP or CVP surface water from its banking partners in years of ample supplies and delivers it to landowners in Kern County for irrigation use in lieu of groundwater pumping. Groundwater which otherwise would have been pumped remains in storage, credited to the account of the banking partner. In times of surface water shortages, the water may be withdrawn and used by Semitropic or other downstream users in exchange for an equal amount of water conveyed to the District from the Sacramento-San Joaquin Delta.

Sustainable Groundwater Management Act (SGMA)
Legislation signed into state law in 2014 with the intent for groundwater to be managed sustainably in California's groundwater basins by local public agencies and newly-formed groundwater sustainability agencies.

Sustainable Yield
As defined in SGMA (Water Code Section 10721), the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.

U

Unconfined Aquifer
An aquifer which is not bounded on top by an aquitard. The upper surface of an unconfined aquifer is the water table.

Undesirable Result
As defined in SGMA (Water Code Section 10721), an undesirable result is one or more of the following effects caused by groundwater conditions occurring throughout the basin:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Urban Water Management Plan (UWMP)
An UWMP is required for all urban water suppliers having more than 3,000 connections or supplying more than 3,000 acre-feet of water. The plans include discussions on water supply, supply reliability, water use, water conservation, and water shortage contingency and serve to assist urban water suppliers with their long-term water resources planning to ensure adequate water supplies for existing and future demands.

W

Water Budget
An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored. See groundwater budget.

Water Year
The period from October 1 through the following September 30, inclusive.

Wellhead Protection Area
The surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

Acronyms and Abbreviations

AF: acre-feet

AFY: acre-feet per year

BAO: Board Appointed Officer

Board: Santa Clara Valley Water District Board of Directors

CASGEM: California Statewide Groundwater Elevation Monitoring Program

CCAMP: Central Coast Ambient Monitoring Program

CEC: Constituents of Emerging Concern

CEO: Chief Executive Officer

County: Santa Clara County

CVP: Central Valley Project

CY: Calendar Year

DDW: State Water Resources Control Board Division of Drinking Water

DEH: Santa Clara County Department of Environmental Health

DFW: California Department of Fish and Wildlife

District: Santa Clara Valley Water District

District Act: Santa Clara Valley Water District Act

DSOD: California Division of Safety of Dams

DTSC: California Department of Toxic Substances Control

DWR: California Department of Water Resources

DWSAP: Drinking Water Source Assessment and Protection Program

EC: electrical conductivity

EDD: Electronic Data Deliverable

EIR: Environmental Impact Report

FAHCE: Fisheries and Aquatic Habitat Collaborative Effort

FWS: United States Fish and Wildlife Service

FY: Fiscal Year (July 1 to June 30)

GAMA: Groundwater Ambient Monitoring Assessment

GCM: General Circulation Model (or Global Climate Model)

GCRCD: Guadalupe Coyote Resource Conservation District

GDE: Groundwater Dependent Ecosystem

GIS: Geographic Information System

Acronyms and Abbreviations

GMMP: Groundwater Mitigation and Monitoring Plan

GSA: Groundwater Sustainability Agency

GSP: Groundwater Sustainability Plan

GWMP: Groundwater Management Plan

IDT: Integrated Device Technology, Inc.

ILRP: Irrigated Lands Regulatory Program

InSAR: Interferometric Synthetic Aperture Radar

IQR: Interquartile range

LAMP: Local Agency Management Plan

LIDAR: Light Imaging, Detecting, and Ranging

LLNL: Lawrence Livermore National Laboratory

LUFT: Leaking Underground Fuel Tank

MCL: Maximum Contaminant Level

MGD: Million gallons per day

MLE: Maximum Likelihood Estimate

MRP: Municipal Regional Permit

MTBE: Methyl tert-butyl ether

NAVD 88: North American Vertical Datum of 1988

NDMA: N-Nitrosodimethylamine

NGVD 29: National Geodetic Vertical Datum of 1929

NMFS: National Marine Fisheries Service

NPDES: National Pollutant Discharge Elimination System

NTU: Nephelometric Turbidity Unit

OWTS: Onsite Wastewater Treatment Systems

PAWS: Protection and Augmentation of Water Supplies

PFAS: Per- and polyfluoroalkyl substances

PFC: Perfluorochemical

PPT: parts per trillion

PSI: pounds per square inch

QA: Quality Assurance

QC: Quality Control

Acronyms and Abbreviations

RCP: Representative Concentration Pathway

RWIG: Recycled Water Irrigation and Groundwater

SBA: South Bay Aqueduct

SBWR: South Bay Water Recycling

SCRWA: South County Regional Wastewater Authority

SCVURPPP: Santa Clara Valley Urban Runoff Pollution Prevention Program

SCVWCD: Santa Clara Valley Water Conservation District

SFEI: San Francisco Estuary Institute

SFPUC: San Francisco Public Utilities Commission

SGMA: Sustainable Groundwater Management Act

SMCL: Secondary Maximum Contaminant Level

SNMP: Salt and Nutrient Management Plan

State Water Board: State Water Resources Control Board

SVAWPC: Silicon Valley Advanced Water Purification Center

SWI: seawater intrusion

SWID: Stormwater Infiltration Device

SWP: State Water Project

TDS: Total Dissolved Solids

TMDL: Total Maximum Daily Load

USEPA: United States Environmental Protection Agency

USGS: United States Geological Survey

UST: Underground Storage Tank

UWMP: Urban Water Management Plan

VOC: Volatile Organic Compound

Water Board: Regional Water Quality Control Board

Water Code: California Water Code

WPCP: Water Pollution Control Plant

WSCP: Water Shortage Contingency Plan

WSMP: Water Supply Master Plan

WTP: Water Treatment Plant

WWTP: Wastewater Treatment Plant

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Appendix A – Board Action and GWMP Outreach

A1. Board Resolution to Adopt the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins and Related Agenda Item, Public Comment Letters Received, and Valley Water Responses

A2. GWMP Outreach – Public Notices

A3. GWMP Outreach – Emails to Interested Stakeholders

A4. GWMP Outreach – List of Meetings Where the GWMP was Discussed

A5. GWMP Outreach – Valley Water Website Information

A6. Environmental Documentation

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Appendix A – Board Action and GWMP Outreach

A1. Board Resolution to Adopt the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins and Related Agenda Item, Public Comment Letters Received, and Valley Water Responses

Santa Clara Valley Water District

CONFORMED COPY

File No.: 21-1075

Agenda Date: 11/23/2021
Item No.: *2.7.

BOARD AGENDA MEMORANDUM

SUBJECT:
Public Hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins, and Resolution Adopting the 2021 Groundwater Management Plan.

RECOMMENDATION:
A. Open the public hearing to receive comments on Santa Clara Valley Water District's 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins;
B. Close the public hearing; and
C. Adopt the Resolution ADOPTING THE 2021 GROUNDWATER MANAGEMENT PLAN FOR THE SANTA CLARA AND LLAGAS SUBBASINS.

SUMMARY:
The Sustainable Groundwater Management Act (SGMA) requires that groundwater sustainability agencies (GSAs) managing medium- or high-priority basins prepare and implement a groundwater sustainability plan (GSP) or an authorized alternative to a GSP under Water Code § 10733.6 (Alternative Plan). As the GSA for the Santa Clara and Llagas subbasins, Santa Clara Valley Water District (Valley Water) developed and adopted, after public hearing, its 2016 Groundwater Management Plan (GWMP) for these basins and submitted it to the Department of Water Resources (DWR) as an Alternative Plan prior to the January 2017 statutory deadline. DWR approved the Alternative Plan in 2019.

As required by SGMA, an updated Alternative Plan must be submitted to DWR by January 1, 2022. Staff has developed Valley Water's 2021 GWMP to be adopted and submitted to DWR as the updated Alternative Plan.

Like the 2016 plan, the 2021 GWMP describes Valley Water goals, strategies, activities, and metrics to ensure continued groundwater sustainability. This memo provides an overview of the major elements of the 2021 GWMP and describes notable changes and updates from the 2016 plan. On October 8, 2021, the draft 2021 GWMP was posted to Valley Water's website for public review at: <https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable>.

Although Valley Water's District Act does not specify that a public hearing is required to enact a groundwater management plan, this hearing provides an opportunity for the public to provide formal input to the Board prior to adoption of the 2021 GWMP. If the Board adopts the 2021 GWMP, it will be

submitted to DWR prior to January 1, 2022 as required by SGMA.

2021 GWMP Overview
While the organization name and purpose have evolved over time, Valley Water was originally formed as a special act district in 1929 for the purposes of managing groundwater. Historically, unsustainable pumping in Santa Clara County resulted in chronic overdraft, land subsidence, and seawater intrusion. While similar problems persist in groundwater basins throughout California, Santa Clara County is recognized as an area where these issues have been, and continue to be, successfully addressed through sustainable groundwater management.

Valley Water's comprehensive groundwater management framework has maintained sustainable conditions in the Santa Clara and Llagas subbasins over many decades. The 2021 GWMP provides detailed information describing this framework, including the following major elements:

- Valley Water history, groundwater management authority, structure, and finances
- Basin setting and conditions including geology, groundwater levels and quality, groundwater dependent ecosystems, land subsidence, and seawater intrusion
- Water supplies, demands, and the groundwater budget
- Sustainable management criteria, including goals derived from Board Ends Policy E-2, effective strategies, and outcome measures to gauge performance
- Basin management programs and activities
- Groundwater monitoring and modeling
- Potential actions to address outcome measure performance and plan recommendations

While all GWMP sections are being updated to represent current basin conditions and Valley Water activities, the fundamental structure and content of the GWMP are largely unchanged as implementation of the plan has proven to be effective in maintaining sustainable groundwater conditions.

Notable changes from the 2016 GWMP include the following, with the first three items supporting related DWR recommendations:

- New and modified outcome measures
- Identification of groundwater dependent ecosystems within the basins
- Evaluation of climate change impacts
- Evaluation of SGMA authorities, including fixed fees and pumping regulation (the latter resulting in new Valley Water policy)

- Description of seawater intrusion mechanisms and risk from sea level rise

A summary of these changes is provided below.

New and Modified Outcome Measures
DWR made several recommendations regarding the outcome measures in Valley Water's 2016 GWMP, including adding a new metric for seawater intrusion and clarifying basin conditions that represent undesirable results. The outcome measures are metrics to gauge performance in meeting sustainability goals and have been modified slightly since 2016. New to the 2021 GWMP are proposed outcome measure-lower thresholds to define undesirable results. A detailed description of the proposed outcome measures and lower thresholds is available in the 2021 GWMP, along with the related rationale.

Valley Water has a long-established history of sustainable groundwater management and will continue to proactively manage groundwater to avoid reaching the outcome measure-lower thresholds and related undesirable results. The new and modified outcome measures in the 2021 GWMP are identified in Table 1 below.

Table 1. Proposed 2021 GWMP Outcome Measures

Sustainability Indicator	Outcome Measure	Outcome Measure - Lower Threshold
Groundwater Storage	Projected end of year groundwater storage is greater than 278,000 acre-feet (AF) in the Santa Clara Plain, 5,000 AF in the Coyote Valley, and 17,000 AF in the Llagas Subbasin.	Projected end of year countywide groundwater storage is greater than Stage 5 (150,000 AF) of the Water Shortage Contingency Plan.
Subsidence	Groundwater levels are above subsidence thresholds at the Santa Clara Subbasin subsidence index wells.	Groundwater levels are above the historical low water levels at the majority of the Santa Clara Subbasin subsidence index wells.
Groundwater Quality	For Santa Clara Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).	At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.
Groundwater Quality	For Llagas Subbasin water supply wells, at least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).	At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.

Seawater Intrusion	In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than the historical maximum extent area (57 square miles).	In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than 81 square miles, which represents a one-mile radial buffer of the historical maximum extent area.

Groundwater Dependent Ecosystems (GDEs)
Using guidance developed by The Nature Conservancy and supported by extensive Valley Water biologist field surveys, the 2021 GWMP presents maps of likely, transition, and possible GDEs for the Santa Clara and Llagas subbasins. As shown in the GWMP, most GDEs are located along stream reaches and in known wetlands. Some GDEs are supported by groundwater only, while others are supported by a combination of groundwater and surface water. The GWMP also provides additional information on groundwater/surface water interaction and notes that staff is not aware of any areas where groundwater pumping has a significant or unreasonable effect on interconnected surface water.

Evaluation of Climate Change Impacts
Using downscaled data from global climate models, model simulations were conducted to project the future groundwater budget, with a focus on how climate change may affect natural recharge. Projected natural recharge in the subbasins ranges from 8 to 19% higher in 2045 compared to the average from 2010 to 2019. Valley Water has initiated a study to evaluate climate change impacts on imported water supply that will consider projected changes in snowpack, streamflow, and sea-level rise beyond Santa Clara County. Results from this new study will be integrated in the next five-year update of the GWMP.

Evaluation of SGMA Authorities and New Valley Water Policy Regarding Pumping Regulation
Following extensive stakeholder engagement through meetings of the Board's Water Conservation and Demand Management Committee (Committee), in February 2018 the Board adopted Resolution 18-04, setting forth the process to regulate pumping under SGMA, if needed. The resolution notes that collaboration will continue to be the preferred approach to address observed or projected undesirable results, and that pumping regulation will only be considered if there is no viable alternative. The process identified in the resolution includes the following basic steps: identification of the issue and potential mitigation; consultation with affected stakeholders to develop an action plan; pumping regulation if voluntary action is not taken or is not successful; and implementation, monitoring and reporting.

In 2018, Valley Water in conjunction with its retail customers explored the idea of implementing a fixed (base) charge that would complement its volumetric groundwater charge, in order to minimize the revenue impact associated with water use decreases such as in a drought. Retail customers generally strongly opposed a fixed charge component for various reasons. As a result, staff recommended suspending the effort to implement a fixed charge component at the full Board meeting on November 27, 2018. Subsequently, the Committee reviewed the reasons for retailer opposition at its March 25, 2019 meeting and agreed with staff's recommendation to not proceed with further development of a fixed charge component at that time. However, implementation of a fixed

charge component remains a potential option for Valley Water in the future.

Seawater Intrusion
In addition to establishing an outcome measure related to seawater intrusion, the 2021 GWMP provides additional analysis and description of seawater intrusion mechanisms. Shallow aquifers near southern San Francisco Bay have been affected by seawater intrusion, primarily due to leakance of saltwater through tidal creeks (as opposed to the more “classic” case of intrusion due to direct hydraulic connection between ocean water and fresh water). The principal aquifer is protected by extensive clays and silts and Valley Water managed recharge that maintains hydraulic gradients toward the Bay.

Outreach and Next Steps
Throughout development of the 2021 GWMP, regular updates have been provided to the Board’s Water Conservation and Demand Management Committee, water retailers, and interested stakeholders. Valley Water hosted a well-attended virtual public meeting on August 12, 2021. As noted above, the draft 2021 GWMP was posted to <https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable> for public review on October 8, 2021. An overview of the 2021 GWMP was provided at the October 25, 2021 Committee meeting.

If the Board adopts the 2021 GWMP, it will be submitted to DWR by January 1, 2022 as Valley Water’s five-year update to the approved Alternative, as required by SGMA.

FINANCIAL IMPACT:
There is no financial impact associated with this item. Activities described in the 2021 GWMP are addressed as part of the annual budget approved by the Board. Water utility projects supporting the protection and augmentation of water supplies are funded through the Water Utility Enterprise fund, which includes revenue from groundwater production charges, treated water charges, and other sources.

CEQA:
This project is exempt from CEQA Guidelines Section 15262 which exempts planning studies.

ATTACHMENTS:
Attachment 1: Notice of Public Hearing
Attachment 2: Resolution
Attachment 3: PowerPoint
Attachment 4: 2021 Groundwater Management Plan
*Handout 2.7-A: D. Muirhead
*Handout 2.7-B: Green Foothills
*Handout 2.7-C: Open Space Authority
*Handout 2.7-D: Change List

UNCLASSIFIED MANAGER:
Greg Williams, 408-630-2867

Public Hearing Notice

2021 GROUNDWATER MANAGEMENT PLAN FOR SANTA CLARA AND LLAGAS SUBBASINS

Santa Clara Valley Water District

Who: **Santa Clara Valley Water District**

What: **Public Hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins**

When: **Tuesday, November 23, 2021, 6:00 p.m.**

Where: **Zoom Teleconference** https://valleywater.zoom.us/j/87901362801

The Santa Clara Valley Water District (Valley Water) invites you to a Public Hearing on the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins. If adopted by the Board of Directors, it will be submitted to the California Department of Water Resources by January 1, 2022 as an update to the approved alternative to a groundwater sustainability plan for these basins pursuant to the Sustainable Groundwater Management Act (SGMA).

The Santa Clara and Llagas groundwater subbasins span nearly 400 square miles in Santa Clara County. The subbasins underlie the valley floor and extend from the county boundaries with San Mateo and Alameda counties in the north, to the Santa Clara/San Benito County boundary in the south. The 2021 GWMP, which describes Valley Water goals, strategies, activities, and metrics to ensure continued groundwater sustainability, is available at https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable.

This meeting is being held in accordance with the Brown Act, as currently in effect. Valley Water's offices are closed to the public. The 6:00 p.m. November 23, 2021 public hearing will be held during a virtual Board Meeting accessible to the public at Zoom link https://valleywater.zoom.us/j/87901362801. Document(s) associated with this hearing are available for public inspection at www.valleywater.org.

For more information, contact Jason Gurdak, Senior Water Resources Specialist, at 408-630-2971.

Valley Water, in complying with the Americans with Disabilities Act (ADA), requests individuals who require special accommodations to access and/or participate in Valley Water Board meetings to please contact the Clerk of the Board's office at (408) 630-2711, at least 3 business days before the scheduled Board meeting to ensure that Valley Water may assist you. Reasonable efforts will be made to accommodate persons with disabilities.

重要通知：

本次会议遵循布朗法案举行。 Valley Water 办公室不对公众开放。 **公众听**证会将在理事会线上会议期间举行，公众可通过以上的Zoom链接访问参与。 **公众可在此**获取与本次听证会相关的文件：www.valleywater.org.**按照《美国残疾人法案》**（ADA）规定，Valley Water **要求出席或参与理事会会**议的有特殊住宿需要的个人，在理事会会议之前至少**3个工作日致**电（408）630-2711，**与**

理事会办公室工作人员联系，以确保相关员工可以为您提供帮助。我们会做出合理的努力，帮助解决残障人士的需求。

Thông Báo Quan Trọng:
Cuộc họp này sẽ được tổ chức theo Đạo luật Brown. Các văn phòng của Valley Water hiện đang đóng cửa không tiếp dân. Phiên điều trần công khai sẽ được tổ chức trong Cuộc Họp Hội Đồng Quản Trị trực tuyến và công chúng có thể truy cập vào theo liên kết Zoom ở trên. Tài liệu liên quan đến phiên điều trần này có thể truy cập để kiểm tra công khai tại www.valleywater.org. Theo Đạo Luật Người Mỹ Khuyết tật (ADA), Valley Water yêu cầu những cá nhân cần sự hỗ trợ đặc biệt để truy cập và/hoặc tham gia vào các cuộc họp Hội Đồng Quản Trị Của Cục Nước xin hãy liên hệ với Thư ký văn phòng Hội Đồng Quản Trị theo số (408) 630-2711 ít nhất 3 ngày làm việc trước khi cuộc họp Hội Đồng Của Cục Nước diễn ra theo lịch để đảm bảo rằng nhân viên của Cục Nước có thể hỗ trợ quý vị. Chúng tôi sẽ thực hiện những nỗ lực hợp lý để hỗ trợ người khuyết tật.

Aviso importante:
Esta reunión se lleva a cabo de acuerdo con la Ley Brown (Brown Act). Las oficinas del Valley Water están cerradas al público. La audiencia pública se llevará a cabo durante una reunión de la Junta virtual a la que el público puede acceder a través del link de Zoom de arriba. Los documentos asociados a esta audiencia están disponibles para la revisión del público en www.valleywater.org. Valley Water, en cumplimiento con la Ley de Estadounidenses con Discapacidades (ADA), solicita que las personas que requieran adaptaciones especiales para acceder o participar de las reuniones de la Junta de Valley Water se comuniquen con el secretario de la oficina de la Junta al (408) 630-2711, al menos 3 días hábiles antes de la reunión programada de la Junta, para asegurarse de que el personal del Distrito pueda ayudarlas. Se realizarán esfuerzos razonables para proveer adaptaciones para las personas con discapacidades.

BOARD OF DIRECTORS
SANTA CLARA VALLEY WATER DISTRICT

RESOLUTION NO. 21- 92

ADOPTING THE 2021 GROUNDWATER MANAGEMENT PLAN FOR THE SANTA CLARA AND LLAGAS SUBBASINS

WHEREAS, the Santa Clara Valley Water District Act (District Act) (California Water Code Appendix, Chapter 60) provides the Santa Clara Valley Water District (Valley Water) with broad groundwater management authority, including the authority to protect, spread, store, retain, and cause water to percolate in the soil within Santa Clara County; and

WHEREAS, Valley Water's statutory boundary wholly overlies the Santa Clara Subbasin and Llagas Subbasin, identified by the California Department of Water Resources as Basins 2-9.02 and 3-3.01, respectively; and

WHEREAS, on September 16, 2014, the Sustainable Groundwater Management Act (SGMA) was signed into law and adopted into the California Water Code, commencing with Section 10720; and

WHEREAS, the legislative intent of SGMA is to provide for the sustainable management of groundwater basins, to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, Water Code Section 10723(c)1(P) identifies Valley Water as one of eighteen (18) agencies created by statute to manage groundwater that shall be deemed the exclusive local agencies within their respective statutory boundaries; and

WHEREAS, on May 24, 2016, the Valley Water Board of Directors adopted Resolution 16-51 on the Decision to Become the Groundwater Sustainability Agency for the Santa Clara and Llagas Subbasins; and

WHEREAS, the Santa Clara and Llagas Subbasins are deemed to be high-priority basins by the California Department of Water Resources (DWR) and therefore require the development of a Groundwater Sustainability Plan or prescribed alternative (Alternative); and

WHEREAS, Water Code Section 10733.6(b)(1) identifies a plan developed pursuant to Part 2.75 (commencing with Section 10750) or other law authorizing groundwater management as an acceptable alternative; and

WHEREAS, Valley Water prepared the 2016 Groundwater Management Plan under authority granted by the District Act and submitted the plan to DWR as an Alternative in December 2016, prior to the statutory deadline of January 1, 2017; and

WHEREAS, in July 2019, DWR approved the 2016 Groundwater Management Plan as an Alternative, confirming it satisfies SGMA objectives for sustainable groundwater management in both basins; and

WHEREAS, Water Code Section 10733.6(c) requires five-year updates to approved Alternatives, with the first updates due to DWR by January 1, 2022; and

WHEREAS, the 2021 Groundwater Management Plan is prepared under authority provided by the District Act and will be submitted to DWR as the required five-year update to Valley Water's approved Alternative; and

WHEREAS, the 2021 Groundwater Management Plan describes Valley Water's comprehensive framework to ensure continued, sustainable groundwater conditions in the Santa Clara and Llagas Subbasins; and

WHEREAS, Valley Water provided updates to interested stakeholders throughout plan development, and prepared and made available a draft of its 2021 Groundwater Management Plan, and noticed a public hearing regarding said plan, which was held on November 23, 2021; and

WHEREAS, the Valley Water Board of Directors considered the 2021 Groundwater Management Plan during a public hearing held on November 23, 2021, and has existing statutory authority to adopt the 2021 Groundwater Management Plan under the District Act.

NOW, THEREFORE BE IT RESOLVED that the Board of Directors of the Santa Clara Valley Water District does hereby adopt the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins.

PASSED AND ADOPTED by the Board of Directors of the Santa Clara Valley Water District by the following vote on November 23, 2021:

AYES: Directors Santos, Kremen, Hsueh, Keegan, LeZotte, Varela, Estremera

NOES: Directors

ABSENT: Directors

ABSTAIN: Directors

SANTA CLARA VALLEY WATER DISTRICT

Tony Estremera

TONY ESTREMERA
Chair, Board of Directors

ATTEST: MICHELE L. KING, CMC

Michele L. King

Clerk, Board of Directors

RL14754

2021 Groundwater Management Plan

Presented by: **Jason Gurdak, Groundwater Management Unit**

November 23, 2021

Valley Water

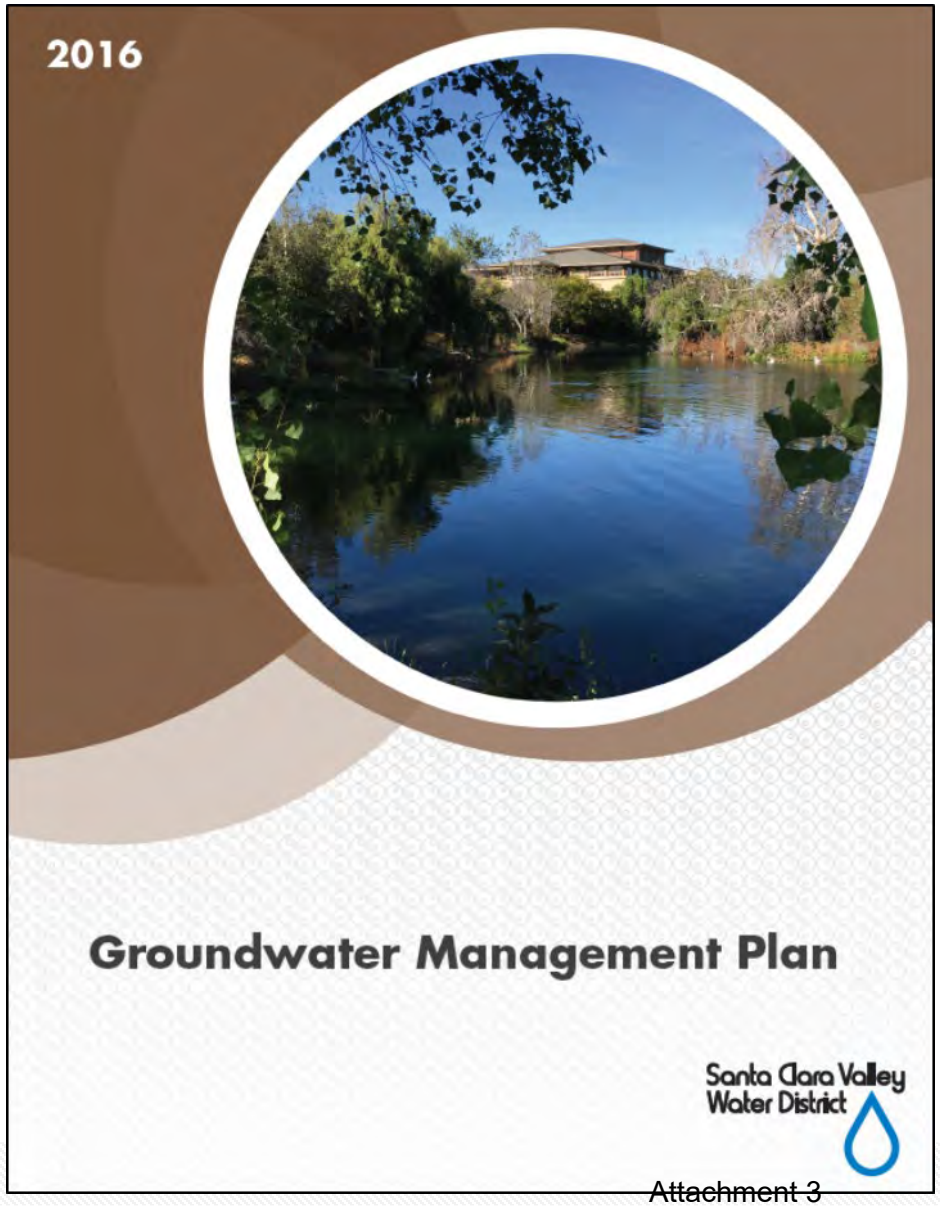
Sustainable Groundwater Management Act (SGMA)

Key elements of State law enacted in 2015:

- Empowers local agencies to form Groundwater Sustainability Agencies (**GSAs**) and provides authorities to manage groundwater
- Agencies must adopt Groundwater Sustainability Plans (**GSPs**) or **Alternatives** and reach sustainability within twenty years (2040 or 2042).
- Focus on local control, but provides for State assistance and if needed, State intervention.

Local SGMA Compliance

- Valley Water is the Groundwater Sustainability Agency for the Santa Clara and Llagas Subbasins
- 2016 Groundwater Management Plan (GWMP) approved by DWR as Alternative
- Five-year update due January 1, 2022



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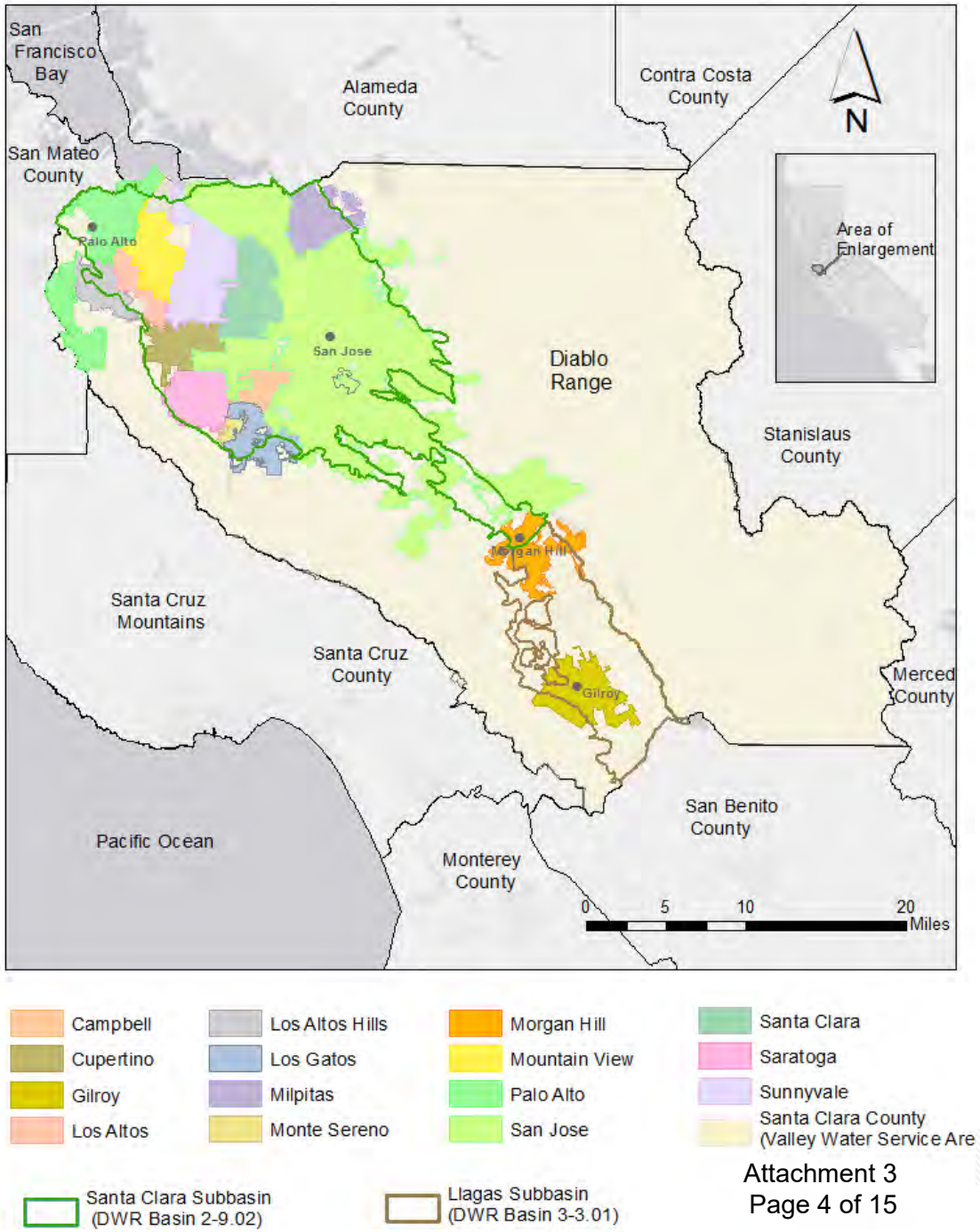
Santa Clara and Llagas Subbasins

- Span nearly 400 square miles
- Provide about 40% of water used countywide
- Serve over 90% of South County water needs



Valley Water

What's in the GWMP?

Detailed information on basins and Valley Water's groundwater management framework:

- Authorities, partners, stakeholders
- Basin setting, conditions, and monitoring
- Water supplies, demands, and groundwater budget
- Sustainability goals, strategies, and metrics
- Programs & potential actions for continued sustainability

Effective Groundwater Management

Long-term groundwater balance due to:

- Managed aquifer recharge
- Treated water, water conservation, recycled & purified water

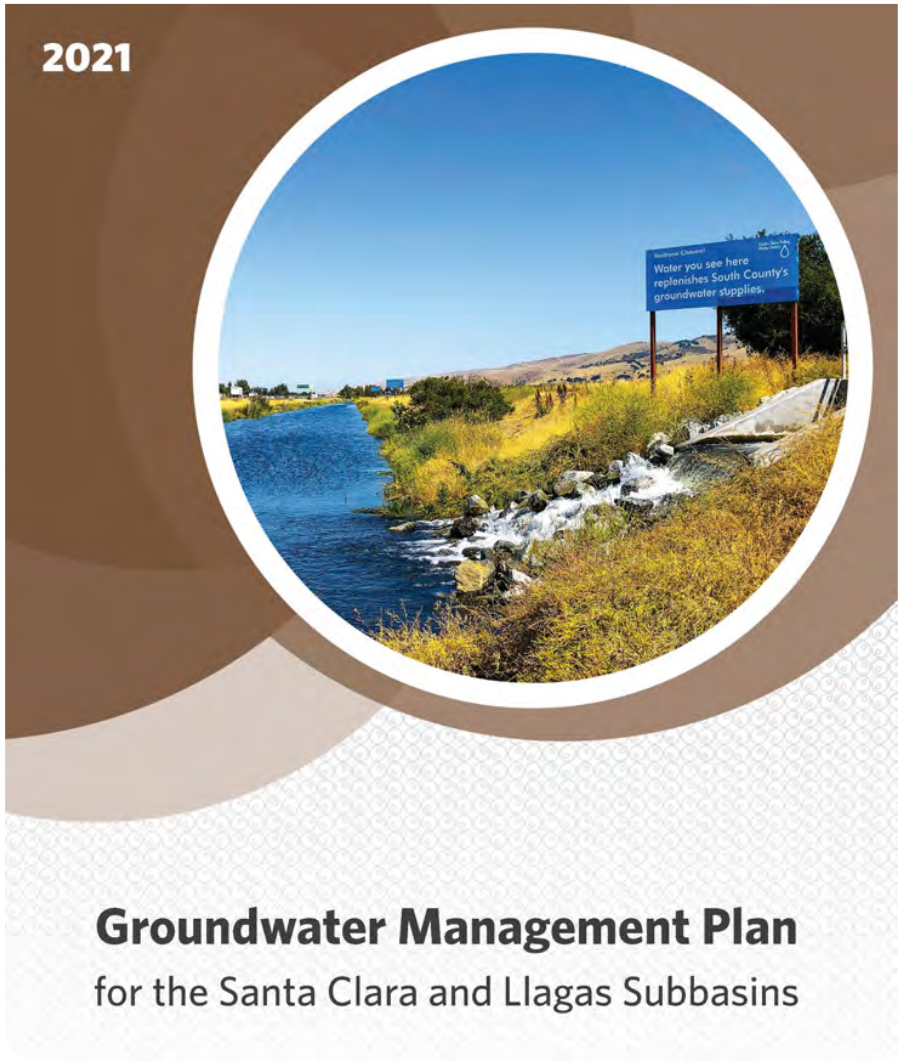
Sustainability supported by:

- Extensive monitoring
- Effective metrics and planning
- Groundwater quality protection
- Coordination with others

Valley Water

Notable Updates in the 2021 GWMP

- New and modified outcome measures
- Groundwater dependent ecosystems
- Climate change impacts
- SGMA authorities (fixed fees and pumping regulation)
- Seawater intrusion



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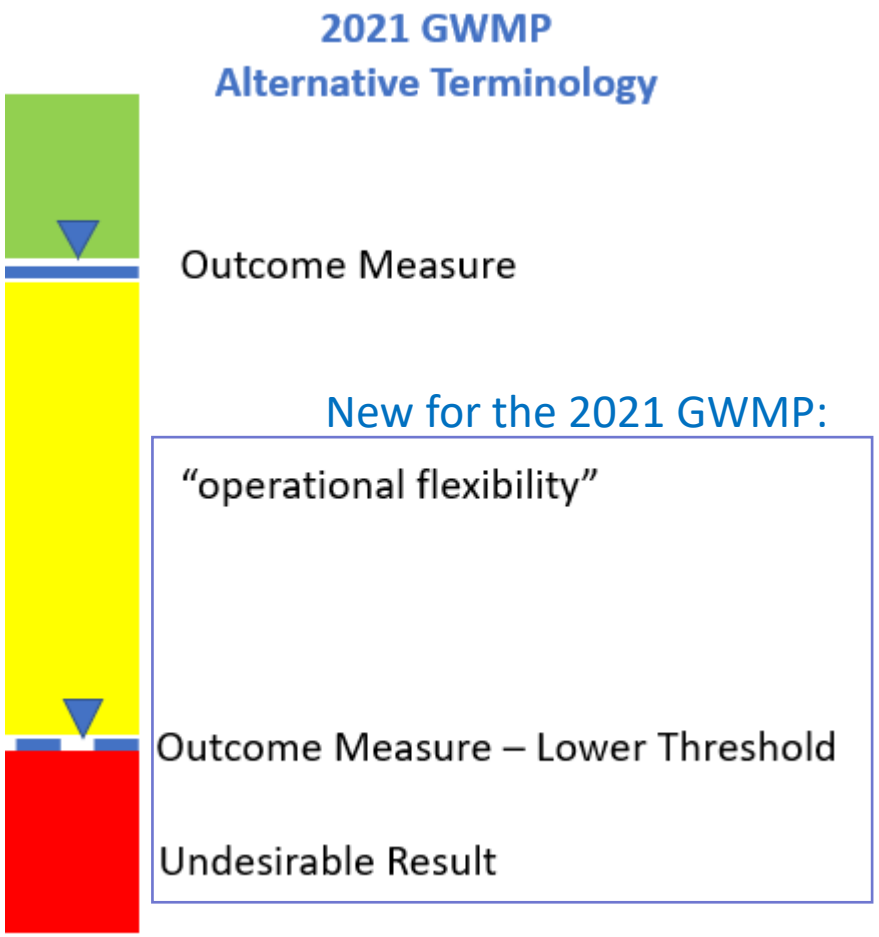
New and Modified Outcome Measures

- Modified outcome measures
- New measure for seawater intrusion*
- New lower thresholds representing undesirable results for:
  - groundwater storage
  - groundwater quality
  - subsidence*
  - seawater intrusion*

*Relevant for Santa Clara Subbasin only



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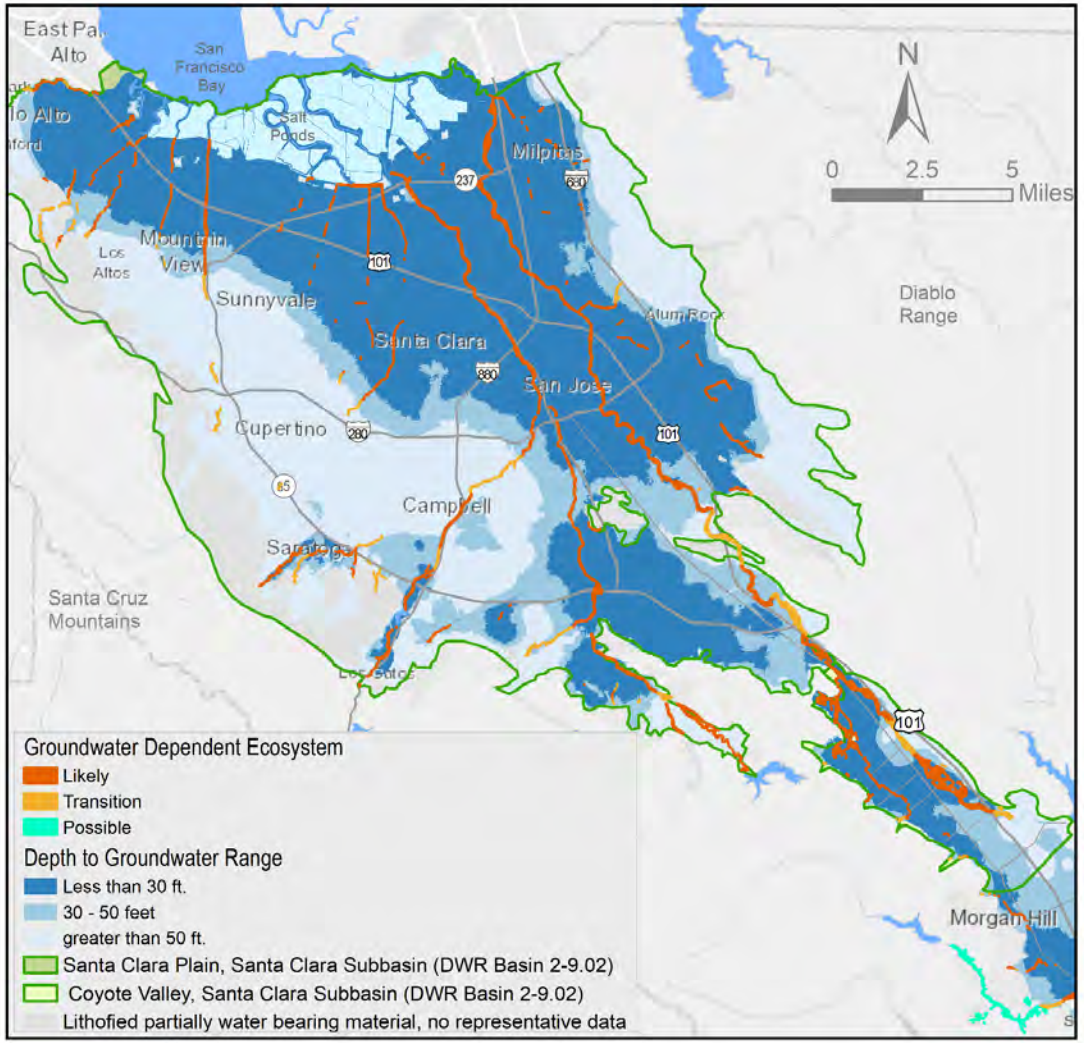
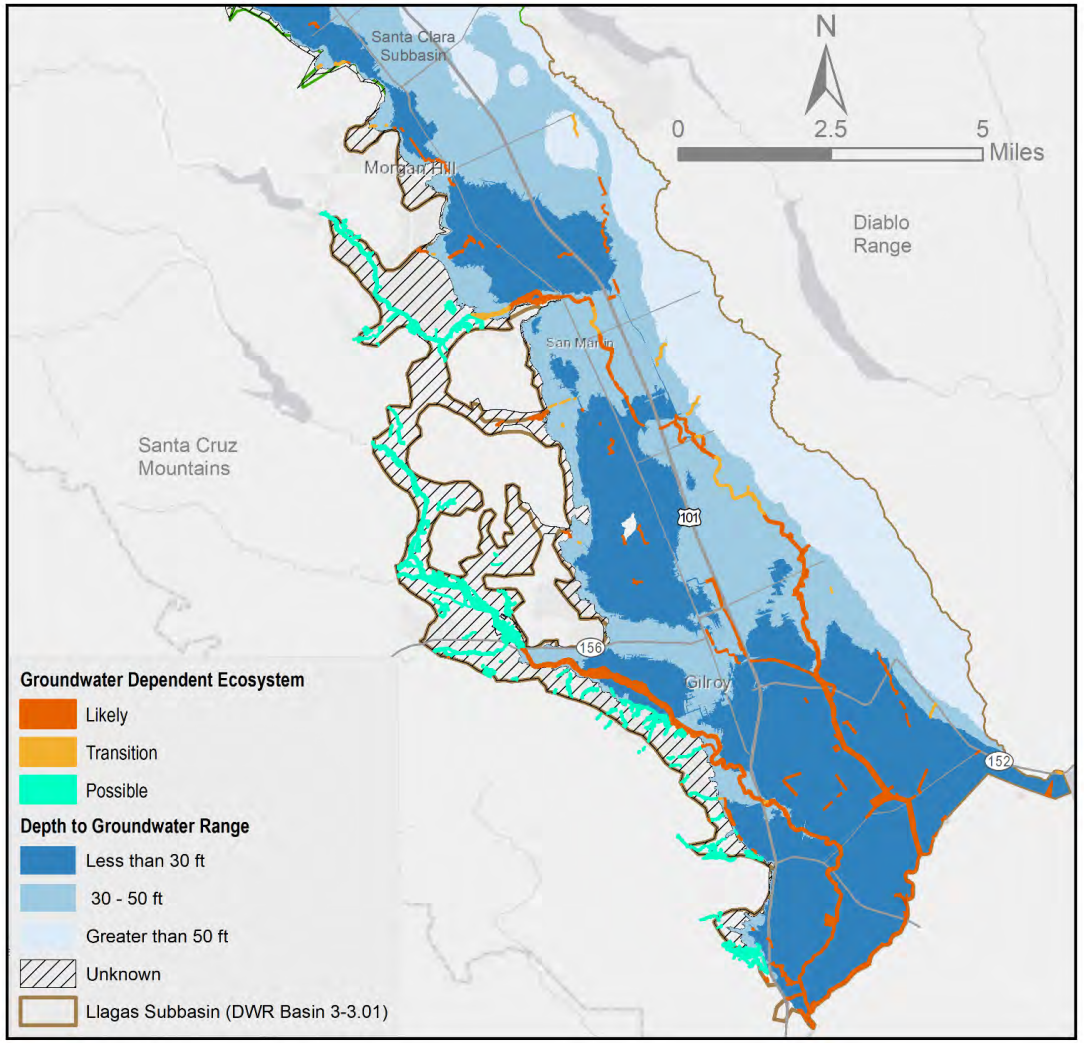
Groundwater Dependent Ecosystems Identified





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Climate Change Impacts to Groundwater Budget

- Slight increases in natural recharge projected
- Projected changes to imported water and local reservoirs will be included in 2026 GWMP

Credit: kwest/Shutterstock.com

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Evaluation of New SGMA Authorities

- Pumping regulation
  - If ever needed, follow process in Board Resolution 18-04
  - If no viable alternative exists
- Fixed fee component of charges
  - Generally opposed by retailers
  - Board opted not to implement
  - Remains a potential future option

BOARD OF DIRECTORS
SANTA CLARA VALLEY WATER DISTRICT

RESOLUTION NO. 18- 04

RESOLUTION MEMORIALIZING THE PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

WHEREAS, the Santa Clara Valley Water District Act (California Water Code Appendix, Chapter 60) provides the District with broad groundwater management authority, including the authority to protect, spread, store, retain, and cause water to percolate in the soil within Santa Clara County; and

WHEREAS, on September 16, 2014, the Sustainable Groundwater Management Act (SGMA) was signed into law and adopted into the California Water Code, commencing with Section 10720; and

WHEREAS, Water Code Section 10720.1 states that, in enacting SGMA, the intent of the legislature is to provide for the sustainable management of groundwater basins, to enhance local management of groundwater consistent with rights to use or store groundwater, to establish minimum standards for sustainable groundwater management, to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater, and to achieve other listed intents; and

WHEREAS, on May 24, 2016, the District Board of Directors adopted Resolution 16-51 on the Decision to Become the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas Subbasins; and

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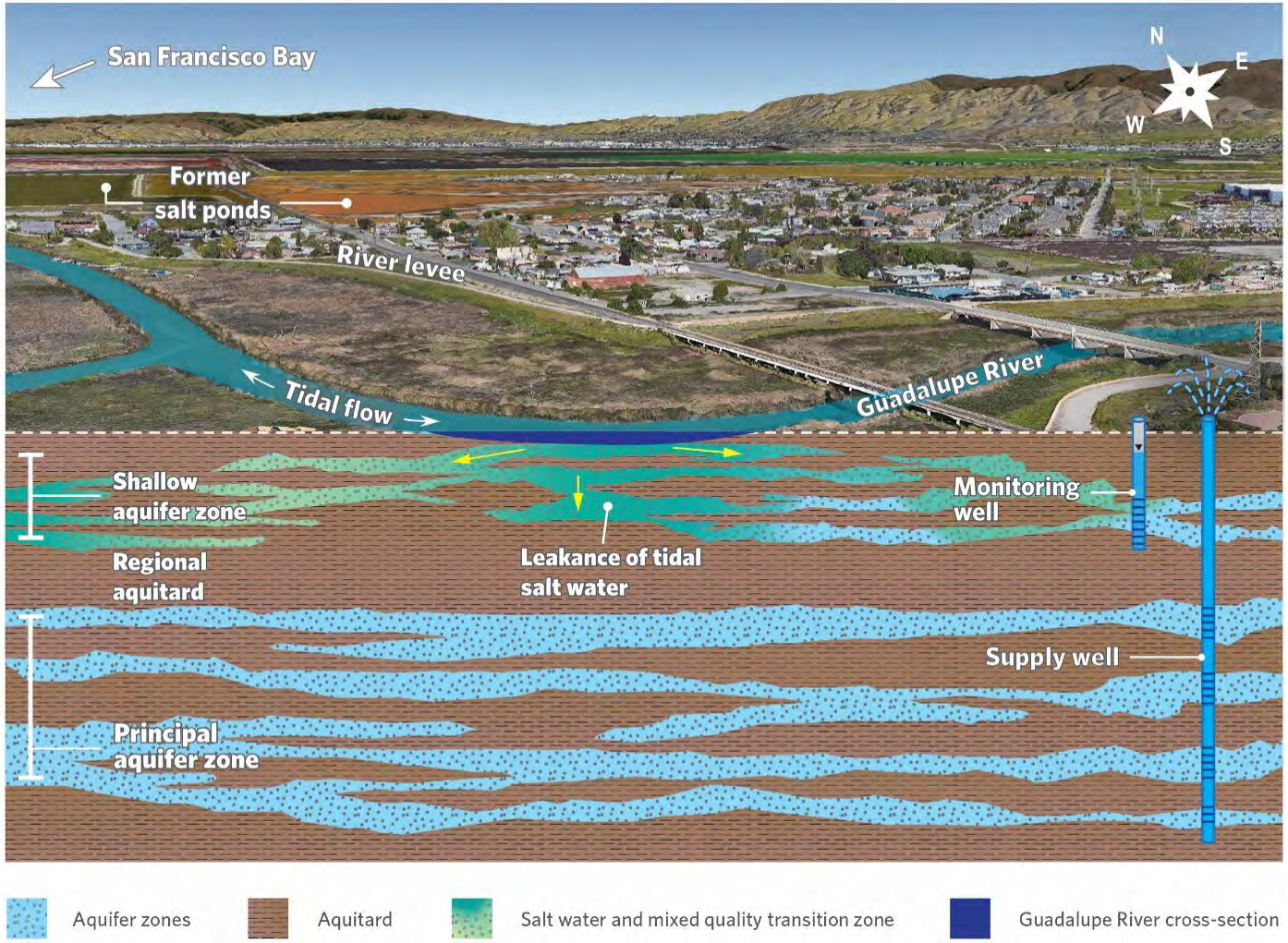
Seawater Intrusion (Santa Clara Subbasin)

- Some shallow aquifer impacts, primarily from leakance through tidal creeks
- Principal aquifer largely protected by geology
- Need to maintain gradient toward Bay



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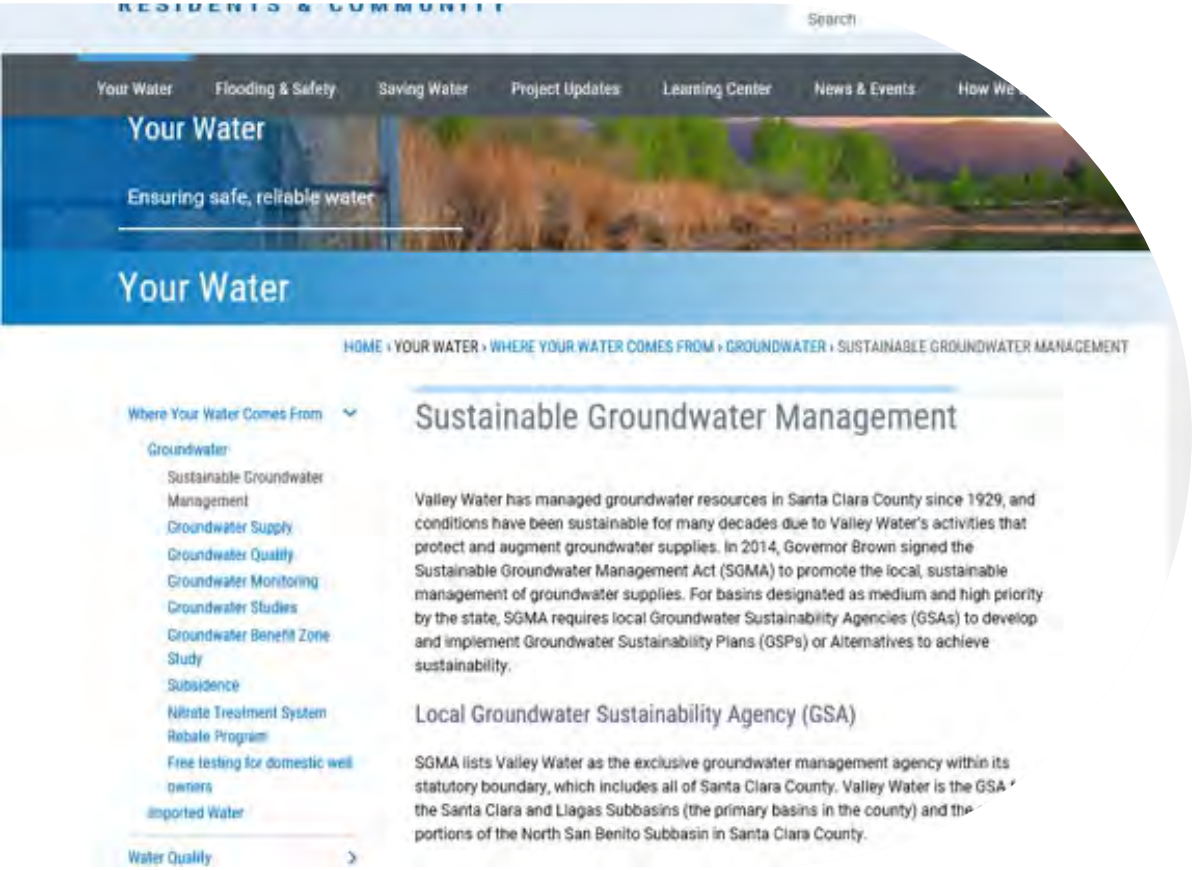
Stakeholder Engagement



- Regular updates to the Water Conservation and Demand Management Committee, water retailers, and interested stakeholders
- Virtual public meeting
- Draft plan posted to website October 8, 2021

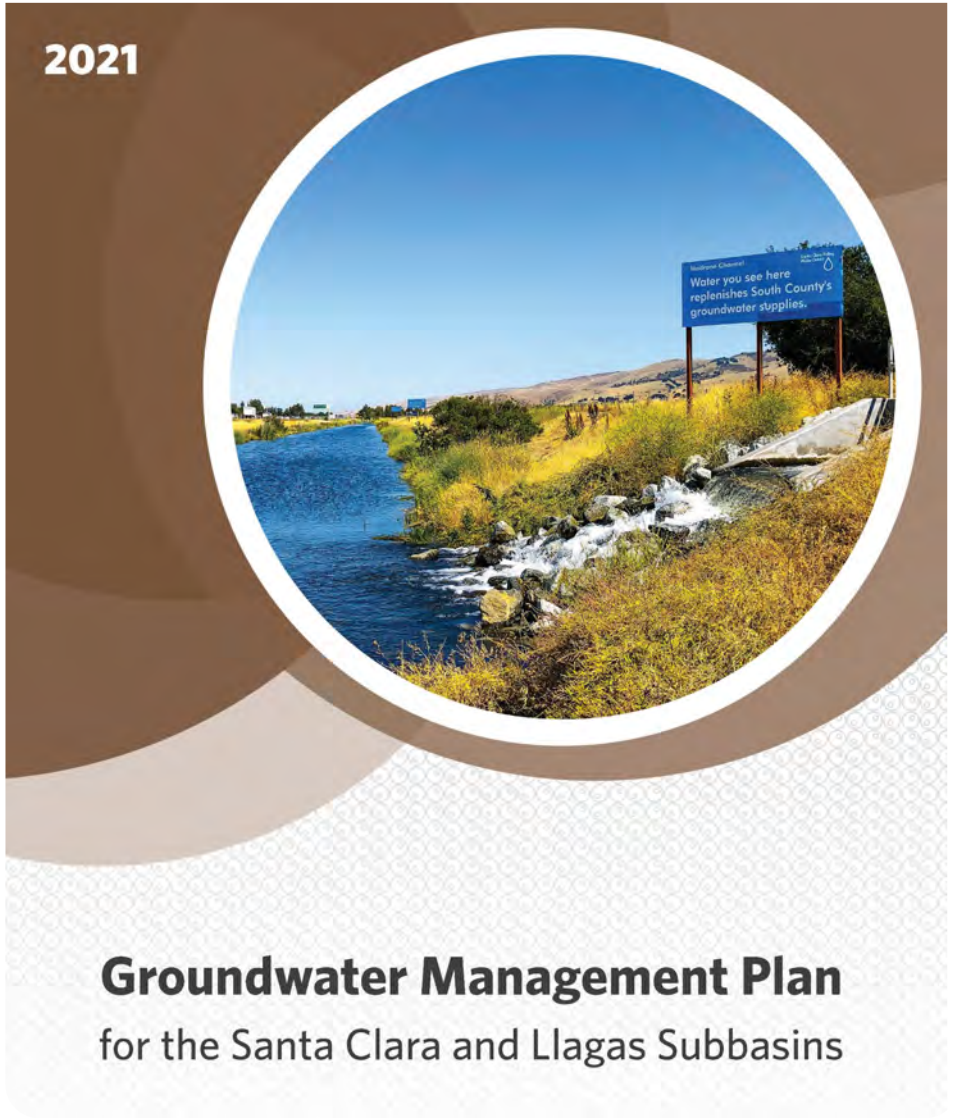
Draft 2021 GWMP available at: https://www.valleywater.org/your-water/where-your-water-comes/groundwater

valleywater.org

Valley Water

Recommendation

Adopt the 2021 Groundwater Management Plan after considering public comments.



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Questions?

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2021

A complete copy of this document can be viewed at the following site:
https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

Groundwater Management Plan

for the Santa Clara and Llagas Subbasins

Valley Water

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Michele King

From: D. Muirhead <doug.muirhead@stanfordalumni.org>
Sent: Sunday, November 7, 2021 8:33 AM
To: Vanessa De La Piedra
Cc: Jason Gurdak
Subject: 2021 GWMP Comments

Hello Vanessa and Jason,
Thank you for your responses to my comments at the Demand Management Committee on October 25. I will use some of the material from that meeting to augment my comments on your draft 2021 Groundwater Management Plan. I know I am not the target audience for this exhaustively comprehensive plan, but I just cannot resist commenting. Buried in this overly-long and occasionally rambling message are perhaps a few opportunities to educate me.

Thank you for your consideration, Doug Muirhead, Morgan Hill

Index
1. hydrogeological composition resistant to subsidence
2. asymmetric relationship Water Retailers vs opaque Stakeholders
3. Framework Flowchart for dealing with undesirable conditions
4. shallow domestic wells and aquifer zones
5. limited well depth information
6. impacts to well users
7. reporting Dry Domestic Wells
8. principles and strategies for drinking water wells
9. better aquifer/aquitard summary
10. criteria for high-priority basins
11. where are the 102 groundwater recharge ponds
12. 2 Regional Water Boards and SCVURPPP
13. contaminating activities should include wildfire impacts
14. statewide airborne electromagnetic (AEM) surveys
15. spelling and glossary

[1. hydrogeological composition resistant to subsidence]
Thank you for noting in the presentation that seawater intrusion and subsidence are of concern in North County but not South County. But Llagas Subbasin Description Land Subsidence [3-12] says
"Inelastic land subsidence has not been observed in the Llagas Subbasin."
and goes on to say that
U.C. Berkeley researchers used satellite imagery to evaluate the potential for subsidence and concluded that there was no evidence of long-term subsidence.
Missing from this evaluation is what was found in the past in other District publications. Which I can no longer find. :-(
You used to describe the "hydrogeological" (if that is the word) composition in South County as being resistant to subsidence.

And George Cook confirmed that in some post-meeting conversation
several years ago..
My interest in this is that I have repeatedly quoted the "resistant
to subsidence" in correcting people who describe subsidence as a
County-wide issue to instead consider this only for North County.

[2. asymmetric relationship Water Retailers vs opaque Stakeholders]
I want to provide my view of the asymmetry of your relationship with
the Water Retailers compared to everyone else as opaque Stakeholders.
From Overview Water Retailers [1-19]
"Valley Water and water retailers collaborate closely on operations
as well as long-term planning and meet quarterly through the Water
Retailers Committee."
In the Drought Emergency Response Report, September 2021, under
Collaboration with the County, Retailers, and Cities, you say
"Valley Water continues to meet with retailers at numerous Subcommittee
meetings to provide drought updates, track progress towards drought
response efforts, and ensure consistent messaging. Valley Water has
also initiated a monthly Ad Hoc Retailer Drought Subcommittee, and
a monthly Subcommittee meeting for drought-related operational updates."
The public is not allowed to observe any of these District-Retailer
interactions nor do we see report-outs from these meetings.
When you had the SGMA plan development meetings, the investor-owned
utilities sent their lawyers.
When it comes to "stakeholders", you mention environmental advocates,
and sometimes the list for other programs mentions "members of the public"
but other times there is no mention of us.
Vanessa did mention notices sent to well owners as an attempt to
increase engagement. But there is no broad attempt to include all
of us who live on the ground above the basin and depend on the basin
for our very lifeblood. I know you think Groundwater Week is a big deal,
and perhaps it is in schools, but it passes unnoticed in Morgan Hill.

[3. Framework Flowchart for dealing with undesirable conditions]
In OVERVIEW Authorities Provided by SGMA [1-14]
"SGMA allows a GSA with an adopted Plan to ..."
but then backpedals with
"SGMA also acknowledges limitations related to the regulations of pumping",
Vanessa mentioned that the framework has multiple off-ramps. These
show up in the textual descriptions of the stages as options.
A Note to the Flow Chart alludes to this:
"Depending on the severity and challenges of the issue identified,
the implementation of any step could be elevated to the Committee
and/or Board."
I see a lack of clarity as to how these would be invoked. My previously-
stated concern is that I see no place where increasing severity requires
shorter response times. You have chosen a different approach.
"the process ... avoids prescriptive triggers and requirements ...and
avoid unnecessary or ineffective actions".
If you did allocations, you might be able to use a local groundwater
trading program as a management mechanism. This was the subject of a
recent webinar

California Water Commission Groundwater Trading Safeguards
for Vulnerable Water Users Workshop [October 2021]

[4. shallow domestic wells and aquifer zones]
You use basin capacity as an outcome measure.
My previously-stated concern is about equity for domestic wells.
But my mental model may incorrectly have shallow domestic wells drawing from the same aquifer as deeper wells for agricultural, municipal, and industrial uses.
In Water Supplies, Demands and Budget [Chapter 4], Groundwater Pumping,
"Groundwater use in the Llagas Subbasin is nearly evenly split between agricultural uses (52%) and municipal and industrial uses (43%), with 5% used for domestic purposes. Pumping by water retailers accounts for about 36% of pumping in the Llagas Subbasin." [Figure 4-5]
In describing the Llagas Subbasin, you say [3-2]
"Within the confined area, low permeability units restrict the vertical flow of groundwater and divide the subbasin into shallow and principal aquifer zones."
I do appreciate Water Supply Well Depth by Well Use Type [Figure 3 D-8].
Perhaps shallow domestic wells draw from a shallow aquifer and are not affected by drawdown in the principal aquifer?

[5. limited well depth information]
Although you provide a number of statistics about wells, I was surprised on the limited number of wells with depth information. Can you determine the depth of an existing well? At what cost? Should this be a gap-filling activity? It would help if you said clearly that only 1,427 supply wells in the Llagas subbasin have well depth information out of 3,989 total wells.

In Evaluation of Dry Supply Wells (Appendix D, 2. Methods), you say [D-10]
"The observed depth to groundwater readings (groundwater levels) and supply well completion depths were compiled from Valley Water databases. It should be noted that Valley Water does not have completion depths for many wells that were installed prior to well permitting regulations, which took effect in the 1970s."
You go on to say in 2.1.2. Well Depth that
"Of the 6,189 supply wells in the Santa Clara and Llagas subbasins, only 2,303, or 37%, have available completed well depth information. Of these wells, the majority (62%, 1,427) are in the Llagas Subbasin and 38% (876) are in the Santa Clara Subbasin."
and in 2.1.3. Well Use Type
"for all 6,198 supply wells in the Santa Clara and Llagas subbasins ... Most active wells are domestic (4,001), followed by M&I (1,062) and agricultural (780). Most standby wells are also domestic (75), followed by agricultural (37) and M&I (14)."
and
"The Santa Clara Plain has the majority (67%, 310) of the M&I supply wells and the Llagas Subbasin has the majority of the agricultural (61%, 171) and domestic (73%, 1,128) supply wells with completed depth information."
I found the fragmentation of information above to be confusing. Combine in one section for readability.

[6. impacts to well users]
In Sustainable Management Criteria [Chapter 5], Outcome Measures [5-6],
"during 2014 and 2015 ... there were very limited impacts to well users, with fewer than 15 reports of wells going dry for domestic wells along the basin margins where well yield is more uncertain (Appendix D)."
In Evaluation of Dry Supply Wells (Appendix D), you say
"Figure 8 supports the prior conclusion that most water supply wells likely had a substantial height of groundwater above the completed well depth and were not vulnerable to going dry during the 20122016."
I am not sure that this proves that we will not have a larger number of dry wells in a future worst-case drought draw-down. But if this conclusion satisfies your team and the professionals at DWR, so be it.

[7. reporting Dry Domestic Wells]
In Evaluation of Dry Supply Wells (Appendix D, 2.3 Reported Dry Domestic Wells During the 20122016 Drought), you say [D-10]
"[water supply wells] were reported by well owners to Valley Water as having gone dry"
Department of Water Resources has a Household Water Supply Shortage Reporting System <https://mydrywell.water.ca.gov/report/>, described as
"This site is for Californians experiencing problems with their private (self-managed) household water supply".
Do you forward dry well reports you receive to DWR? Do you also look at their dry-well reports? Is the mechanism for reporting dry wells one of the things you put in your notices to well owners?

[8. principles and strategies for drinking water wells]
Do you expect that the definition of undesirable conditions will be modified as a result of California Department of Water Resources (DWR), in coordination with the State Water Resources Control Board, developing principles and strategies related to groundwater management and drinking water well impacts? They hosted Listening Sessions (June 29-30) and a Public Workshop (July 22).

[9. better aquifer/aquitard summary]
I particularly liked the narrative in Appendix H Seawater Intrusion [H-10].
"Below the regional aquitard is the principal aquifer that is used as a public water supply. The shallow multi-layered aquifer zone is generally not used as a public water supply.
The shallow aquifer zone has relatively small seasonal fluctuations in water levels because this zone has limited groundwater pumping.
The principal aquifer zone has relatively larger seasonal fluctuations in water levels because of substantial groundwater pumping.
Perhaps similar wording could be added to
3.1.3 Principal Aquifers and Aquitards
preceding
Cross-sections of the Llagas Subbasin are presented in Figures 3-3 - 3-6.

[10. criteria for high-priority basins]
Both Executive Summary [ES-1] and Introduction [1-1] say
"DWR has identified the Santa Clara and Llagas subbasins

as high-priority basins"
but I would include in ES-1 the remainder of the statement in 1-1
"based on criteria that include overlying population, projected growth, number of wells, irrigation acreage, groundwater reliance, and groundwater impacts. Neither subbasin has been identified as being critically overdrafted."
since a common misperception is that "high/medium" priority equates to "troubled".

[11. where are the 102 groundwater recharge ponds]
The Water Supply and Groundwater Overview [ES-2] claims
102 groundwater recharge ponds covering 277 acres
but Overview Figure 1-4 [1-8] shows only 17 Recharge Ponds not 102.
Maybe [number of ponds] notation next to triangle?

[12. 2 Regional Water Boards and SCVURPPP]
In both CHAPTER 6 BASIN MANAGEMENT PROGRAMS AND ACTIVITIES
and CHAPTER 7 GROUNDWATER MONITORING AND MODELING
you describe the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) without mentioning that this is under the authority of the SF Bay Regional Water Board and that there is not a counterpart for South County under the authority of the Central Coast Regional Water Board.
Contrast this with a section in Chapter 7 that refers to a Central Coast Ambient Monitoring Program (7.4.3.1) and then refers to the North County counterpart as SCVURPPP.

[13. contaminating activities should include wildfire impacts]
In 6.3.4 Watershed Management you say
"protect the water quality and water supply ... from potentially contaminating activities."
Although Erosion, Debris Flow, and Flooding are surface water issues, they can affect groundwater. I remember an exchange several years ago with a senior staff member who said that the Madrone Channel was empty because there was too much sediment in the water available for recharge.
I do not know how Groundwater Management interfaces with Watersheds.
I do not know what came of a January 2017 Joint Meeting of the Santa Clara Valley Water District Board of Directors and the Santa Clara Valley Open Space Authority Board of Directors to discuss the potential for collaboration regarding watershed management following the Loma Fire.
If you have the time, I found the Loma Fire Watershed Emergency Response Team Final Report (CA-SCU-006912 October 25, 2016) a fun read.
The burn area was predominantly located within two watersheds, the Upper Llagas Creek and the Upper Uvas Creek watersheds. Approximately 35% of the burn area was in the Uvas Creek basin and 63% in the Llagas Creek watershed. Llagas Creek flows into Chesbro Reservoir and Uvas Creek flows into Uvas Reservoir.

[14. statewide airborne electromagnetic (AEM) surveys]
In NEXT STEPS [CHAPTER 8], 8.3 GROUNDWATER MANAGEMENT PLAN RECOMMENDATIONS
one topic is to

"Maintain adequate monitoring programs and modeling tools."
The upcoming statewide airborne electromagnetic (AEM) surveys do not list Santa Clara County and especially the Llagas subbasin as candidates, even though the Department of Water Resources (DWR) webinar on June 8, 2021 claimed that AEM data will be collected in all high- and medium-priority groundwater basins, where data collection is feasible, and will start Summer 2021 and continue over the next several years.

[15. spelling and glossary]
[spelling] ES-4 "this subbasins is"
[spelling] 1-1 "Alternative Pan"
[define] H-2 "semiperched groundwater" not defined until H-10 in text;
not defined in glossary

November 19, 2021

Vanessa De La Piedra, Groundwater Management Unit Manager
Santa Clara Valley Water District

Re: **Comments on 2021 Draft Groundwater Management Plan for the Santa Clara and Llagas Subbasins**

Dear Ms. De La Piedra,

Green Foothills submits the following comments on Valley Water's 2021 Draft Groundwater Management Plan for the Santa Clara and Llagas Subbasins (Draft Plan).

As a general matter, we support and ask Valley Water to adopt the seven comments and recommendations from the Santa Clara Valley Open Space Authority (OSA) letter of November 19, 2021, attached separately. In particular, we wish to emphasize and expand on the seventh comment regarding the importance of the Coyote Valley area. As Valley Water's own November 16, 2021 letter to San Jose City Council (also attached) states:

The Santa Clara Subbasin begins in the Coyote Valley, then flows north under San José and Santa Clara toward the Bay. Development in Coyote Valley could convert pervious soil to impermeable concrete, pavement, and buildings, flushing water into streams and the Bay rather than letting it percolate to groundwater. In most parts of the subbasin, but not in Coyote Valley, the drinking water aquifer is deep underground, and extensive clay layers provide some natural protection from contamination. In Coyote Valley, the drinking water aquifer is often very close to the surface and the soils allow relatively rapid downward percolation, making groundwater there highly vulnerable to contamination. Industrial contamination in Coyote Valley could potentially impact not only local groundwater users, but also those drawing on the subbasin in San José and other downgradient areas.

We suggest this language be included in the Draft Plan in an appropriate location, possibly in section 6.2.4 or 6.2.5.

Finally, the attached 2018 analysis "Coyote Valley and Groundwater Protection" draws heavily from the Santa Clara Valley Water District's 2010 Revised Final Groundwater Vulnerability Study (Groundwater Study), with the gratefully-acknowledged help of data provided by Valley Water. The 2018 analysis concludes that Coyote Valley is uniquely vulnerable and available to substantial reduction in vulnerability by protecting the groundwater from incompatible development. Since then, two things have occurred. San Jose land use protections recommended by Valley Water in its letter have passed, eliminating any additional industrial uses beyond existing developed parcels, and in addition 1400 acres in Coyote Valley are now publicly owned, so vulnerability to farming operations and fertilizer contamination can also be managed in cooperation with the public agencies that own the land. We suggest the Draft Plan acknowledge the vulnerability and the change since the 2010 Groundwater Study. We also suggest the Draft Plan recommend Valley Water's cooperation with San Jose and Santa Clara County as land use agencies, and with San Jose and OSA as landowners to achieve reductions in

groundwater vulnerability. This cooperation could include financial “buy-in” or other incentives from Valley Water.

Thanks for this opportunity to comment. Please contact us with any questions.

Sincerely,

Brian Schmidt
Legislative Advocacy Director

Andrea Mackenzie, General Manager
Alex Kennett, District 1
Mike Flaugher, District 2
Helen Chapman, District 3
Dorsey Moore, District 4
Shay Franco-Clausen, District 5
Mike Potter, District 6
Kalvin Gill, District 7

November 19, 2021

Santa Clara Valley Water District
Vanessa De La Piedra, Groundwater Management Unit Manager

RE: 2021 Draft Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Dear Ms. De La Piedra,

On behalf of the Santa Clara Valley Open Space Authority (Authority), thank you for the opportunity to provide comment on Valley Water's Draft Groundwater Management Plan (Draft Plan).

The Open Space Authority is a public, independent special district created by the California State Legislature in 1993 to conserve the natural environment, support agriculture, and connect people to nature by protecting open spaces, natural areas, and working farms and ranches for future generations.

Valley Water serves a critical role as our Groundwater Sustainability Agency (GSA), where it is responsible for delivering sustainable groundwater conditions in Santa Clara County. The Draft Plan is proposed to serve as the Groundwater Sustainability Plan update for Santa Clara County, which requires Valley Water to outline specific sustainable groundwater management criteria that avoid the six undesirable results outlined by the Sustainable Groundwater Management Act (SGMA), including the avoidance of depleted interconnected surface waters that supply water to Groundwater Dependent Ecosystems (GDEs) like wetlands, wetted stream channels, and riparian corridors.

We applaud Valley Water for its work to map GDEs in the Draft Plan and we are grateful for Valley Water's ongoing groundwater management actions that help maintain our aquifers in long-term balance. Nevertheless, the Draft Plan fails to include sustainable management criteria that avoid the depletion of interconnected surface waters, the only SGMA undesirable result not addressed in the Draft Plan, and one that is critical for Valley's Water's responsibility as a GSA, its mission to "Provide Silicon Valley safe, clean water for a healthy life, environment, and economy", and its Ends Policy E-4 "Water resources stewardship protects and enhances ecosystem health". Despite the immense efforts of Valley Water, we continue to observe the depletion of interconnected surface waters in our GDEs due to declines in groundwater levels. One particularly notable example being Fisher Creek and the Laguna Seca wetland complex in Coyote Valley, which underwent significant periods of drying during the 2012-2016 drought and are currently nearly completely dry as groundwater levels decline in the Coyote Valley.

As you know, the Authority, its conservation partners, and funders, have invested over $150million to date to permanently protect nearly 1,500 acres of land in Coyote Valley that encompass groundwater dependent ecosystems in and around Fisher Creek and the Laguna Seca wetland complex (**Exhibit A attached**). This includes more than $32 million in state grants from the California Natural Resources Agency (CNRA), Department of Conservation, Strategic Growth Council, Wildlife Conservation Board, and the State Coastal Conservancy. These lands will be subject of the Coyote Valley Conservation Areas Master Plan, an integrated restoration master plan process, which will enable large-scale restoration actions to begin within the next 3-5 years. In restoring Coyote Valley's groundwater-dependent ponds, wetlands, and riparian channels, our aim is to protect surface and groundwater quality and promote habitat conditions favorable to the recovery of rare, threatened, and endangered species such as California red-legged frog, California tiger salamander, and tri-colored blackbird among others.

Valley Water is a key partner of the Authority where its groundwater management actions are essential for the protection and restoration of groundwater dependent ecosystems in Coyote Valley. Given Valley Water's unique role, commitment to environmental stewardship and responsibilities under SGMA, we respectfully provide the following comments on the Draft Plan:

1. **Consider updating the Draft GSP's sustainability goal to specifically include sustainable supplies for all groundwater users (including the environment).**

   The Draft GSP identifies two sustainability goals: (1) "Manage groundwater to ensure sustainable supplies and avoid land subsidence", and (2) "Aggressively protect groundwater from the threat of contamination. While Valley Water has been able to provide long term balance of our aquifers, groundwater dependent ecosystems rely on groundwater supplies being maintained at or near the ground surface to sustain these ecosystems. Please consider updating Goal (1) to "Manage groundwater to ensure sustainable supplies *for all groundwater users, including environmental users of groundwater,* and avoid land subsidence".

2. **Include a new outcome measure and outcome measure lower thresholds that, if met, would avoid the depletion of interconnected surface waters.**

   The Draft GSP currently lacks sustainability criteria that directly addresses the depletion of interconnected surface waters. The Department of Water Resources' Alternative Assessment Staff Report: Santa Clara Subbasin (2-009.02) sent on July 17, 2019 stated that "…sustainable management criteria have not been established to avoid significant and unreasonable depletion of interconnected surface water." and "GSP Regulations specify that the minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.". Please consider adding a sixth outcome measure and lower threshold that would avoid depletion of interconnected surface waters.

3. **Consider developing an estimate of a sustainable yield or sustainable recharge that avoids undesirable results**

   The Authority wishes to support the long-term viability of land uses that are compatible with groundwater sustainability, and do not contribute to the depletion of the aquifer. The Draft Plan states "Valley Water does not manage to a particular value for sustainable yield, but instead manages groundwater to maintain sustainable conditions through annual operations and long-term water supply planning.". If Valley Water does not wish to provide a sustainable yield, please consider providing an estimate of sustainable recharge levels so that land use agencies and water users know what amount of water extraction is possible in areas like the Coyote Valley management area without exceeding Valley Water's recharge capabilities.

4. **Consider updating groundwater models to evaluate seasonal fluctuations in surface water groundwater interactions**

   The Draft GSP states "models are used to evaluate and forecast groundwater storage and water levels under various operational and hydrologic conditions. Maintaining calibrated models that can reasonably forecast groundwater conditions is an important part of Valley Water's comprehensive groundwater management strategy". It appears that some of Valley Water's groundwater models do not directly consider the interaction between groundwater and surface water and how that relates to the health of groundwater dependent ecosystems. Please consider updating your groundwater models to enable estimates of seasonal fluctuations in groundwater levels, since seasonal variability drives the health and sustainability of groundwater dependent ecosystems. The Authority is currently in the process of securing a consultant team for the Coyote Valley Conservation Areas Master Plan that will develop a SWAT-MODFLOW model of the Coyote Valley Management Area to better understand interconnected surface water behavior. We appreciate the Groundwater Unit's willingness to serve as a collaborator and technical adviser on this work and the Authority hopes this modeling could be useful for Valley Water's groundwater

condition forecasting and management activities that support groundwater dependent ecosystems.

5. **<u>Consider opportunities to pilot or implement voluntary actions that address groundwater demand, especially when sustainability indicators are not being met.</u>**

   Piloting tools, frameworks, and programs that support voluntary reductions in pumping could be an essential first step in addressing groundwater overdraft conditions without requiring regulatory action. Please consider potential next steps or opportunities to explore or implement programs like groundwater trading programs, farmland fallowing programs, ag irrigation efficiency grants, or voluntary agreements with well users to reduce pumping when sustainability indicators are not being met. The Authority and Peninsula Open Space Trust hold a conservation easement over the City of San Jose's land in Coyote Valley that requires the City consider reducing groundwater extraction from its municipal wells when they contribute to unsustainable groundwater conditions in Coyote Valley. We are in the process of determining the tools and frameworks that will be required to do this and appreciate the Valley Water Groundwater Unit's willingness to partner with us on this work and hope to develop new tools and monitoring frameworks that will make it easier for well operators to voluntarily reduce pumping when groundwater levels are trending in an unsustainable direction.

6. **<u>Add the Laguna Seca wetland complex and Fisher Creek as locations of known groundwater emergence.</u>**

   Figure 20 in the Draft GSP, "Likely Groundwater Emergent Areas in the Santa Clara Subbasin" does not include Fisher Creek or the Laguna Seca wetland complex, likely due to limitation in the resolution of GIS data that was used to identify those areas. However, the report recognizes Fisher Creek and Laguna Seca as locations of interconnected surface waters and groundwater dependent ecosystems. Please consider a manual update to Figure 20 to include Fisher Creek and Laguna Seca as groundwater emergent areas.

7. **<u>Add acknowledgment that Coyote Valley is a resource of statewide significance.</u>**

   a. AB-948 was approved by the Governor on September 27, 2019, authorizing the Authority to administer a newly created Coyote Valley Conservation Program, and declaring Coyote Valley is a resource of statewide significance. The bill requires that Coyote Valley to be acknowledged as an area of statewide significance in local planning documents developed or updated on or after January 1, 2020, affecting land use within Coyote Valley. Please add this acknowledgment given Coyote Valley land uses depend on groundwater, including the Authority's ongoing management and restoration of groundwater dependent ecosystems in and around Laguna Seca and Fisher Creek.

Thank you for your consideration.

Sincerely,

Andrea Mackenzie
General Manager

CC: Santa Clara Valley Open Space Authority Board of Directors

Exhibit A: Coyote Valley A Conserved Landscape- showing recently protected valley floor lands outlined in yellow

Handout 2.7-B
11/23/21

Valley Water

Clean Water • Healthy Environment • Flood Protection

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Michele L. King, CMC

November 16, 2021

City of San José
Mayor and City Council
200 East Santa Clara Street, 18th Floor
San José, CA 95113

Re: Item #10.3 on November 16, 2021 City Council Agenda

Dear Mayor and City Council:

Valley Water appreciates the opportunity to comment on the proposed development of Coyote Valley. First, Valley Water supports items 1 through 5 recommended by staff, rather than the Planning Commission's direction to deny staff's recommendation at their October 27, 2021 Planning Commission meeting. Furthermore, Valley Water would also like to take this opportunity to respond to comments and questions from Planning Commissioners related to the price of water, and the availability of water, for Coyote Valley farmers. Statements that were made suggested that the availability and/or cost of water were reasons why farming isn't viable as a business in Coyote Valley, and thus recommended against the staff and General Plan Task Force proposals to protect Coyote Valley from further development.

Valley Water has not wavered in its commitment to provide a safe, clean water supply to not only the farming and agricultural communities, but to all communities here in Santa Clara County. Price and availability of water are competitive advantages for Coyote Valley farmers compared to other regions such as the Central Valley, Imperial Valley, and elsewhere. This is due to the natural advantages of climate, rainfall, and depth of groundwater, as well as the many decades of sustainable groundwater management by Valley Water. Because of our activities to replenish and protect local aquifers, groundwater is readily available and sustainable throughout Coyote Valley to support agricultural, domestic, municipal/industrial, and environmental uses.

Valley Water worked with the County and Open Space Authority on the Santa Clara Valley Agricultural Plan, which "acknowledges the vital importance of Santa Clara Valley agriculture to the region for long-term sustainability and health of our county." Valley Water's agricultural rate is lower than its municipal and industrial rate to encourage open space preservation, which is important to watershed health. Agricultural and open space can replenish local groundwater by allowing water to infiltrate and recharge aquifers, unlike developed areas with associated impervious surfaces. Valley Water continues to support the viability of agriculture in the County through sustainable groundwater management and by keeping agricultural water rates low.

While our surface water reservoirs are crucial, more water is stored in local groundwater basins than all of our reservoirs combined. The Santa Clara Subbasin begins in the Coyote Valley, then flows north under San José and Santa Clara toward the Bay. Development in Coyote Valley could convert pervious soil to impermeable concrete, pavement, and buildings, flushing water into streams and the Bay rather

than letting it percolate to groundwater. In most parts of the subbasin, but not in Coyote Valley, the drinking water aquifer is deep underground, and extensive clay layers provide some natural protection from contamination. In Coyote Valley, the drinking water aquifer is often very close to the surface and the soils allow relatively rapid downward percolation, making groundwater there highly vulnerable to contamination. Industrial contamination in Coyote Valley could potentially impact not only local groundwater users, but also those drawing on the subbasin in San José and other downgradient areas.

Finally, Coyote Valley in its current state also provides benefits to improve or maintain a healthy watershed ecology. Water-dependent species like Western pond turtles, California tiger salamanders, and red-legged frogs need a healthy environment around their waterways. Open space and agricultural habitats are much more compatible with wildlife than new development. The loss of Coyote Valley as open space could potentially harm the environment, and new roads or increased traffic threatens wildlife corridors for small animals as well as larger ones like bobcats and deer. Coyote Valley could continue to be a thriving valley-bottom watershed ecosystem if it is preserved as such.

Valley Water greatly respects the autonomy and authority of the Council in its decisions such as this; please know this letter is only intended to provide clarity and respond to points raised from the Planning Commissioners for your consideration, while also offering other potential environmental impacts for your consideration. We would respectfully request that you support the staff recommended actions, and we stand ready and willing to support you in your environmental stewardship of the precious water and lands we have here in our county.

Thank you for your time and consideration, and please feel free to reach out to Don Rocha, Deputy Administrative Officer for Government Relations, should you have any questions or concerns at (408) 630-2338 or at drocha@valleywater.org.

Sincerely,

Tony Estremera
Chair, Board of Directors

cc: Board of Directors (7), R. Callender, M. Richardson, R. Gibson, D. Rocha
bz:jh
1116a-l

COYOTE VALLEY & GROUNDWATER PROTECTION

NORTH COYOTE VALLEY PRESENTS A UNIQUE OPPORTUNITY TO PROTECT GROUNDWATER QUALITY FROM A POTENTIAL THREAT TO THE DRINKING WATER FOR THOUSANDS OF SAN JOSE RESIDENTS. Physical characteristics of the land make it one of the most vulnerable areas in the county for contamination, but widespread industrial development has not yet occurred. The risk from that development can still be prevented entirely, while in already-developed areas it can only be managed. Local government agencies should undertake proactive policies and purchases in light of the combined opportunity and vulnerability for San Jose's groundwater supplies.

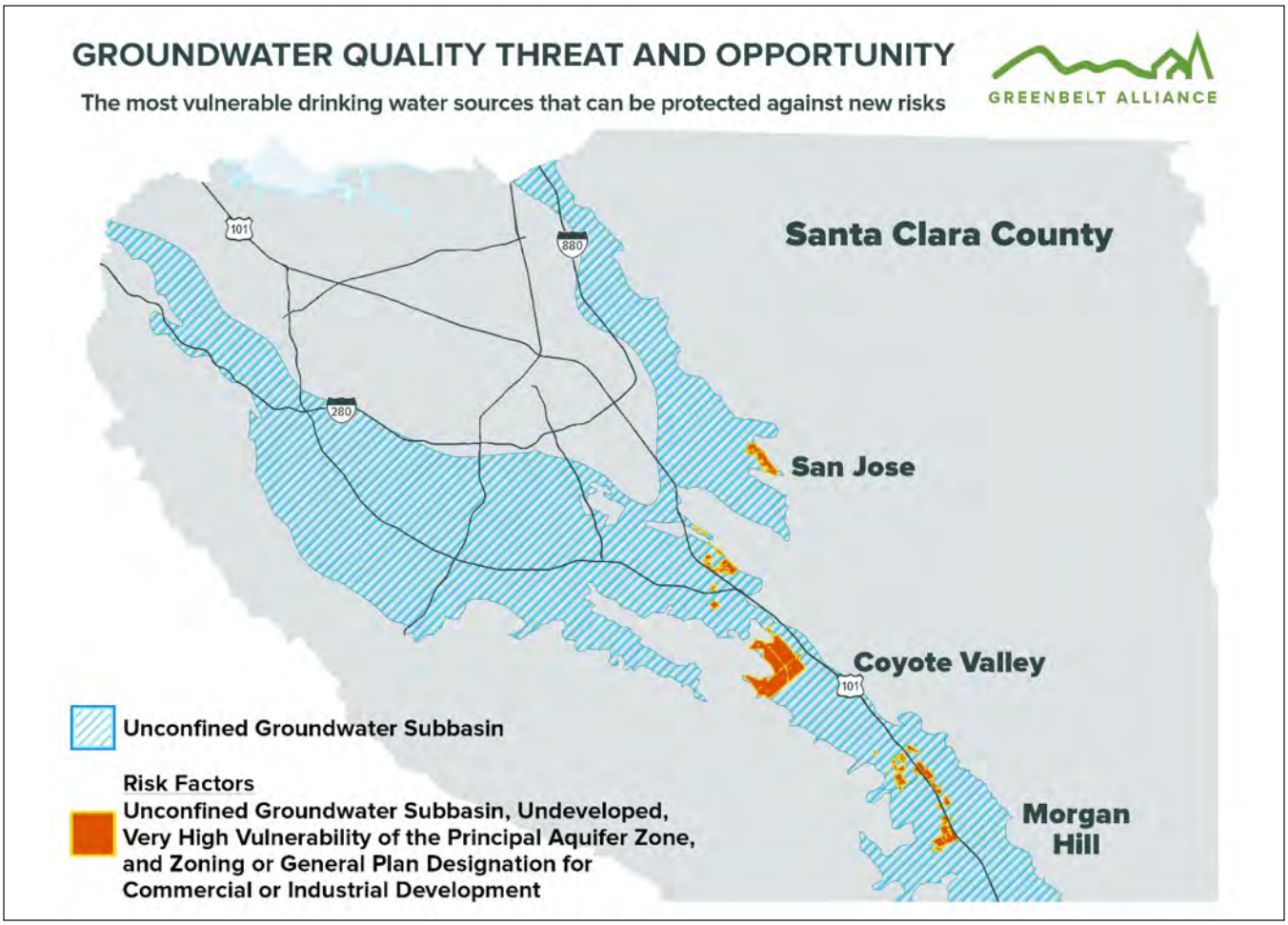
GREENBELT ALLIANCE

Brian Schmidt, Program Director
bschmidt@greenbelt.org | 415-543-6771 x303

The map below draws from the Santa Clara Valley Water District's *Revised Final Groundwater Vulnerability Study (Groundwater Study)*, and from land-use zoning and General Plan designation mapping to identify a combination of factors showing which land is most vulnerable to harm to groundwater quality and can most easily be protected.

Features of the Threat and Opportunity Map:

- The unconfined subbasin aquifer, shown on the map as the "Unconfined Groundwater Subbasin," is an area where underground drinking water sources are more vulnerable than the rest of the county. The remaining gray areas on the map are either hilly areas without large aquifers, or "confined" aquifers where drinking water sources deep underground are partially protected by intervening layers of clay and separate, shallow aquifers above that clay.
- "Very High Vulnerability" is the Water District's own most vulnerable rating category in its model. The study combined physical characteristics of the land in the county that increase or decrease the consequences if a contamination event occurred, together with the land uses that occur there that increase or decrease the likelihood of a contamination event. Combined, they measure vulnerability, and only a small part of the entire county is rated "Very High".
- Undeveloped land zoned for commercial or industrial development presents a great opportunity for groundwater protection. Much of the threat to drinking water results from potential future development, but because the land is still vacant, the opportunity remains to find an alternative use that does not create this risk. Existing risk from undeveloped land uses (e.g. farming activities) could be limited through purchase of easements or fee title.



- The Water District does monitor groundwater for contamination, but the monitoring is not a guarantee against any contamination. Monitoring will only detect contamination after it has spread far enough to reach a monitoring location.

Why Coyote Valley Stands Out:

- Unlike most other locations, the drinking water aquifer is very near the surface. A contamination event that might not even reach the groundwater table in other locations will reach it in Coyote Valley and then become mobilized with the moving groundwater.
- Water moves quickly through Coyote Valley sediment, both vertically and horizontally. This means contamination may reach groundwater quickly and then move quickly to contaminate the aquifer further north.
- The speed at which groundwater moves in Coyote Valley could make it more difficult for groundwater monitoring to respond in time to limit additional contamination, even assuming the contaminant is being monitored.
- North Coyote Valley represents by far the largest geographic area with combined significant risk and significant opportunity to avoid inappropriate development.
- The three other areas also rated highly in this analysis are distinguishable from Coyote Valley in that they are generally small, scattered parcels that would be difficult to acquire or manage for agricultural benefit, they are surrounded on most or all sides with urbanization that makes their own development nearly inevitable or, in the case of the Evergreen Industrial Park, have no near-term prospects for industrial development. Regardless, even if the other three areas are considered equivalently important, over half (1,363 acres of 2,484 acres) of the priority land that is most vulnerable and feasibly protected is located in North Coyote Valley.

The Problem at Coyote Valley Could Be Even Worse Than It Appears:

- Several reasons suggest that this map is a conservative estimate of the risk from North Coyote Valley. It is at the most upstream portion of the broader Santa Clara Valley aquifer, so underground water flows north from it through much of the remaining aquifer. By contrast, other potential contamination sites further north could harm a smaller portion of the aquifer. In addition, a surface-spill contamination event in Coyote Valley that reached Fisher Creek or Coyote Creek would rapidly move north past Coyote Valley in Coyote Creek's surface water. Contamination moving in this surface water percolates down into the drinking water aquifer for another mile before being stopped at the shallow aquifer (and then contaminating that shallow aquifer as well).[1]
- Allowed land use includes industrial use with significant risk of contamination.
- The "Very High Vulnerability" rating for Coyote Valley could underestimate the future risk in that area. The study acknowledges the risk of future development in the text, but the risk weighting would become even worse if the area is developed. See *Groundwater Study* at page 61.

Coyote Valley, especially North Coyote Valley, stands at the confluence of threat and opportunity. With industrial development just a possibility rather than an on-the-ground reality, the risk that development entails can be entirely prevented rather than simply managed. The following recommendations for Santa Clara Valley Water District and other agencies present significant opportunities to protect San Jose's groundwater.

Recommendations for Water District and Other Agency Policies:

- The Water District has an existing policy that groundwater basins be "aggressively protected from contamination and the threat of contamination." (*Vulnerability Study*, page 18.) Both this policy and new policies should help guide how the Water District acts regarding Coyote Valley.
- Where undeveloped land in the unconfined aquifer is highly vulnerable only because of potential development, the Water District should support reasonable efforts to maintain the land's use in a non-developed state.
- In addition, the Water District should fully communicate to the City of San Jose and the public regarding the risk and consequences of groundwater contamination in Coyote Valley, including extensive, multi-year cleanup costs that may be passed along to retail water agencies and potential inability to use groundwater sources in the event of contamination.[2]
- The Water District should investigate the creation of and funding of groundwater protection easements that prevent uses and development that pose contamination risks. The easements could allow existing agriculture to continue while restricting agricultural practices that increase risk.
- The Santa Clara Valley Open Space Authority should support groundwater protection policies such as those described above for the Water District and for land use agencies.
- The Open Space Authority should support funding and protection of land for reasons of groundwater protection.
- The Open Space Authority and the Water District should consider an agreement with each other granting to the Water District a groundwater quality protection easement for land owned by the Open Space Authority in Coyote Valley. See the Supplemental Information Section of this document for more details.
- The City of San Jose should consider re-designating North Coyote Valley to maintain its existing agricultural and other open space use in order to protect the City's groundwater quality.
- The City of San Jose should consider funding and supporting the funding of land acquisition and easement acquisition for purposes of protecting groundwater quality.

Handout 2.7-B
11/23/21

SUPPLEMENTAL INFORMATION

- SELECTED CASES OF CONTAMINATION IN SANTA CLARA
- CASE STUDY: AUSTIN TEXAS GROUNDWATER PROTECTION PROGRAM OF LAND PURCHASES
- GROUNDWATER EASEMENT
  - GENERAL CONCEPT
  - SPECIFIC APPLICATION TO OSA AND POST LAND
- METHODOLOGY AND COMPONENT MAPS
  - DISCLAIMER REGARDING SHALLOW AQUIFERS

Selected Examples of Groundwater Contamination in Santa Clara County

Multiple groundwater contamination events have occurred in Santa Clara County, with more federal Superfund sites than any other county in the US. Fortunately, the most dangerous events have generally occurred in northern parts of the county where clay layers create shallow aquifers that trap contamination before it reaches the drinking water aquifer. This pattern highlights the risk of putting industrial development in Coyote Valley, where the drinking water aquifer is unshielded and near the surface.

Below are some contamination examples. More information can be found at the Santa Clara Valley Water District and its *Groundwater Study*.[3]

Perchlorate and Volatile Organic Compound (VOC) contamination:

- Middlefield-Ellis-Whisman & Moffett Field (349 acres)
- National Semiconductor (195 acres)
- Varian, 601 California Ave. (175 acres)
- Hewlett-Packard, 395 Page Mill Rd. (175 acres)
- Hewlett-Packard, 640 Page Mill Rd. (175 acres)
- FEI (TRW), 825 Stewart Dr. (124 acres)
- Mohawk Laboratories (110 acres)

Notes: the above contamination all happened in areas protected by the shallow aquifer. Most also did not reach deep levels, averaging a depth only 40 feet below ground. The drinking water aquifer in Coyote Valley, however, is closer to the surface than 40 feet.

- Fairchild: this Superfund site was located in South San Jose, an area not protected by clay layers and a shallow aquifer, resulting in drinking water aquifer contamination and significant cleanup costs. Even this location was not quite as vulnerable as Coyote Valley, with a greater depth to groundwater.
- Olin Facility Perchlorate: the most serious drinking water aquifer contamination was from perchlorate contamination in Morgan and San Martin, in the Llagas sub-aquifer that drains south instead of north. A nine-mile plume costing millions of dollars for cleanup resulted from this contamination. Again, this area was not protected by shallow aquifers, and was contaminated although groundwater levels were deeper and less exposed to contamination than in Coyote Valley.

Groundwater Quality Conservation Easement

General Concept

In order to protect groundwater drinking sources in the Santa Clara Valley Subbasin from the unique contamination issues in Coyote Valley, the Water District should acquire easements from Coyote Valley landowners. Two possible uses of the easement include restrictions on certain types of activities when the land is in agricultural use and/or easements that restrict industrial activities. An easement applied to any particular property would not need to restrict both types of uses (e.g., restrict certain agricultural practices without being applicable if the land is converted to industrial use).

An agricultural-groundwater protective easement would restrict activities that increase the risk of contamination. Most prominently, it would reduce the risk of nitrate contamination from fertilizer use, given that that is the main agricultural contamination issue for groundwater. It could prohibit certain kinds of uses of fertilizer, mandate certain types that limit contamination if fertilizer is used, or simply set standards for the maximum amount of fertilizer applied per acre per time period. It could also prohibit certain kinds of pesticides or allow only certain other pesticides to avoid other contamination issues. The easements could potentially include related groundwater issues like limitations on certain types of irrigation that use excessive amounts of water.

An industrial-use groundwater conservation easement could function at several alternative levels. At the broadest, it might prohibit all industrial and all other non-open space use of the property. This level would be similar to a general purpose conservation easement, but it might be useful as a way to divide up the value of conserving the land, where a certain amount is paid to recognize the monetary value of protecting groundwater quality, while other sources pay for the other environmental values in land protection.

Less broadly, an industrial groundwater conservation easement could protect against limited types of uses that jeopardize groundwater without prohibiting industrial usage outright. A specifically important and relevant example would be to prohibit warehouses on the property. Even if toxics are theoretically prohibited from being stored, actually enforcing that prohibition against, for example, a contractor temporarily storing something in violation of the terms is extremely difficult. Prohibiting warehouse uses outright would be much more enforceable and effective. Other uses might face restrictions, e.g. prohibiting certain types of toxic materials from being stored or used at all and/or maximizing the amount of toxics that can be stored at any one time.

The Water District can make use of the Drinking Water State Revolving Fund as a source to pay for groundwater protection easements (see "Using the Drinking Water State Revolving Fund for Source Water Protection Loans" at https://www.epa.gov/sites/production/files/2015-04/documents/landmanage.pdf).

POST/OSA Pilot Project with the Water District

A pilot-project version of the groundwater quality conservation easement could be part of an exchange between POST or OSA and the Water District. The Water District's vulnerability study for North Coyote Valley shows a significant vulnerability due to agricultural practices that constitute potentially contaminating activities. Coyote Valley land currently controlled by those two agencies could be managed in a way that prohibits those activities.

We suggest the following exchange:

- POST/OSA grants an agricultural groundwater quality conservation easement (and possibly an industrial groundwater quality conservation easement) to the Water District that prohibits certain potentially contaminating activities. Terms of the easement would be subject to negotiation with the Water District, sufficient to result in revision of the Groundwater Vulnerability analysis as described in Part 2 below. An agricultural groundwater quality easement would only restrict agricultural uses; if Coyote Valley is ultimately developed and POST/OSA decide not to keep all of their parcels undeveloped, then the easement would not prohibit development.
- In compensation for the easement, the Water District will revise the 2010 Groundwater Vulnerability analysis to reflect the increased protections on the property with the easement, with the terms of the easement negotiated to be sufficiently strict to revise downward the Vulnerability Analysis of the parcels with the easements.[4]

No money needs to be transferred, which simplifies and facilitates the pilot project. As a result of this exchange, the Water District can guarantee incrementally better protection of groundwater than had previously been the case and can show its progress in its primary analysis. POST or OSA get recognition of the environmental values they seek to protect while giving up only the ability to conduct certain agricultural practices they would likely want to avoid. Together the three agencies have established a mechanism and example for future groundwater quality conservation easements that could protect additional properties in Coyote Valley or elsewhere.

San Antonio and the Edwards Aquifer Example

San Antonio, Texas, together with other areas of Texas, draws its primary water supply from the Edwards Aquifer. This parallels the situation with Santa Clara County, where the groundwater table stores twice as much water as all local reservoirs put together. Just as Coyote Valley is associated with important wildlife values, the Edwards Aquifer supports unique ecological values.

After a major, multi-year drought, Texas and its local governments embarked on a number of measures to protect their groundwater aquifer. Over the years, the protections involved a mix of regulatory actions, water conservation plans, and purchases. Beginning in 2000 and with regular renewals thereafter, San Antonio voters authorized a sales tax of one-eighth percent to purchase conservation easements on a voluntary basis from landowners. The easements prevent further subdivision of property and usually amount to significantly less than the land's total value. The program has protected over 130,000 acres and is intended to protect water quality as well as quantity.

Similar programs exist in other parts of Texas to protect Edwards Aquifer. Austin has been involved in both regulating and purchasing development rights in the parts of the aquifer that provide water to the city. Controversies over protection of the land mirror those seen in Coyote Valley. A documentary movie, *The Unforeseen*, was made about that process that begins with the Wendell Berry poem, "Santa Clara Valley," highlighting our area as a cautionary example where development here in Silicon Valley has ignored the natural resource values of the land and water. Excerpts of "Santa Clara Valley" are quoted below:

I walked the deserted prospect of the modern mind where nothing lived or happened that had not been foreseen. What had been foreseen was the coming of the Stranger with Money. All that had been before had been destroyed: the salt marsh of unremembered time, the remembered homestead, orchard and pasture….

New buildings, built to seal and preserve the inside against the outside, stood in the blatant outline of their purpose in the renounced light and air. Inside them were sealed cool people, the foreseen ones, who did not look or go in any way that they did not intend….

Outside, what had been foreseen was roaring in the air. Roads and buildings roared in their places on the scraped and chartered earth; the sky roared with the passage of those who had been foreseen toward destinations they foresaw, unhindered by any place between. The highest good of that place was the control of temperature and light…I could not see past it but to its ruin.

I walked alone in that desert of unremitting purpose, feeling the despair of one who could no longer remember another valley where bodies and events took place and form not always foreseen by human, and the humans themselves followed ways not altogether in the light, where all the land had not yet been consumed by intention, or the people by their understanding, where still there was forgiveness in time, so that whatever had been destroyed might yet return. Around me as I walked were dogs barking in resentment against the coming of the unforeseen.

And yet even there I was not beyond reminding…The coots and gallinules skulked in the reeds, the mother mallards and their little ones afloat on the seaward-sliding water to no purpose I had foreseen. The stilts were feeding in the shallows, and the killdeer treading with light feet the mud that was all ashine with the coming da*y. Volleys of swallows leapt in joyous flight out of the dark into the brightening air in eternal gratitude for life before time not foreseen, and the song of the song sparrow rang in its bush.*

Local California agencies here in Santa Clara County could consider following the environmental leadership demonstrated in Texas.

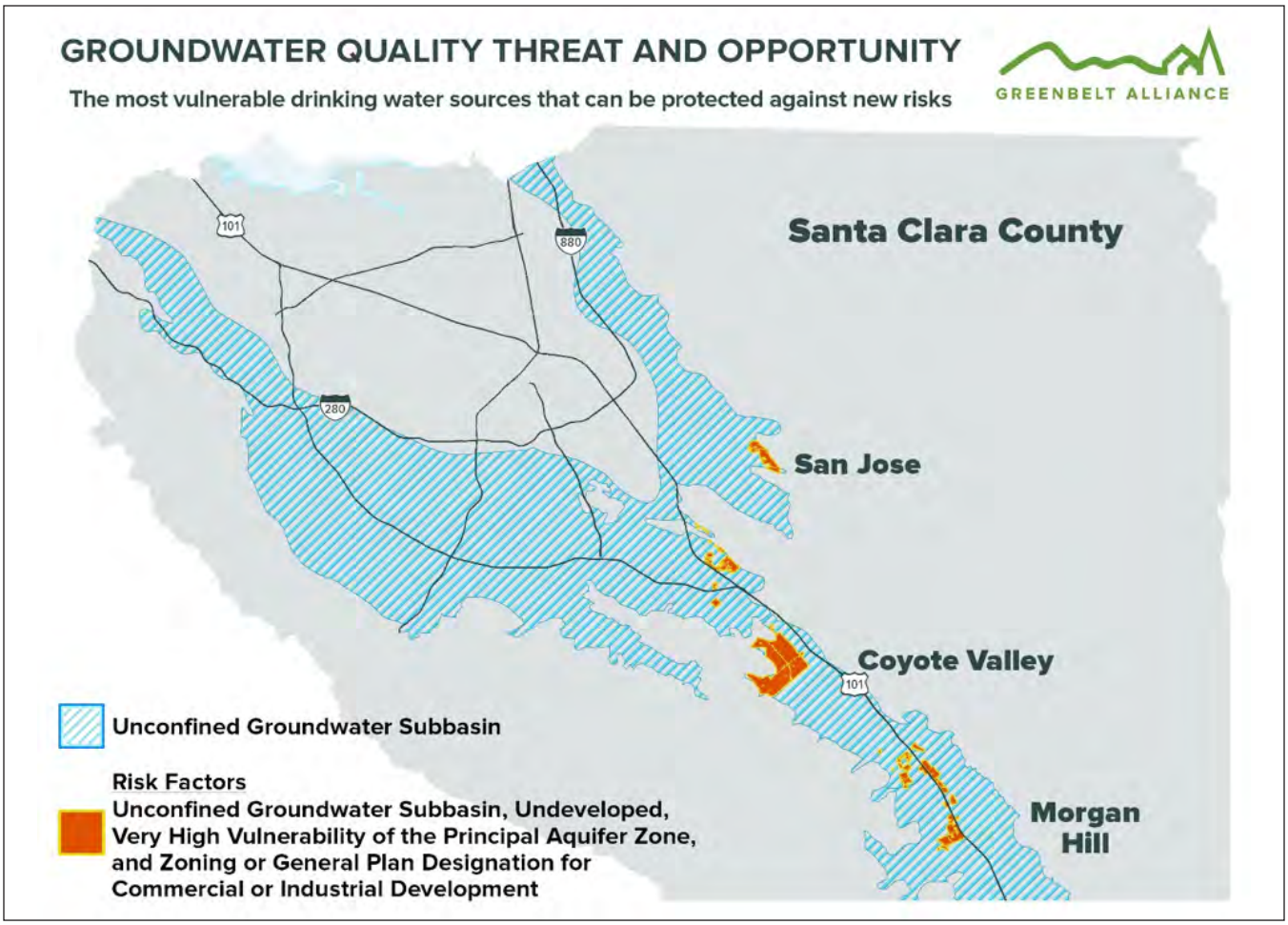
Handout 2.7-B
11/23/21

Greenbelt Alliance Methodology for This Analysis

Greenbelt Alliance's research objective was to map where the greatest overlap exists between groundwater vulnerability on the one hand, and on the other hand, the opportunity to prevent that vulnerability threat because the development has not yet occurred. This analysis relies on the greater ability to prevent a threat if the development posing the threat has not yet occurred.

The analysis also makes use of the information that drinking water aquifers in much of Santa Clara County are partially protected from surface contamination by impermeable clay "aquitard" layers and shallow aquifers above the clay layers. Contamination from the surface affects those shallow aquifers long before it reaches the (in places, very deep) underlying drinking water aquifer. The methodology here prioritizes groundwater that is not confined and protected by clay layers and shallow aquifers (called "unconfined aquifers").

The prioritization of unconfined aquifers does not in any way assume that protecting the confined aquifers or shallow aquifers is unimportant. Both confined aquifers and shallow aquifers have important functions for people and ecology. The ongoing cleanup of some contaminated shallow aquifers is necessary and an important lesson about preventing contamination threat where we can. This analysis simply focuses on the greater threat where aquifers are unconfined.



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Mapping Analysis

To create the Groundwater Quality Threat and Opportunity Map for this report, Greenbelt Alliance researchers created a map that overlapped multiple GIS layers from governmental source data. The analysis overlays:

- GIS mapping data layers from the Water District's 2010 Groundwater Vulnerability analysis showing the highest rating ("Very High Vulnerability") for the principal aquifer;
- from the same Groundwater Vulnerability analysis, a map layer showing the Unconfined Aquifer portions of the principal aquifer;
- GIS mapping data layers from Santa Clara County and cities showing zoning and General Plan designation for commercial and industrial development; and
- mapping layers showing the land that is undeveloped.

The first three factors show where the threat to drinking water aquifers is potentially the greatest, while the fourth shows where there is at least a theoretical opportunity to prevent that threat because the development has not yet occurred.

As described above, Greenbelt Alliance used the following map layers to create the final version.

THREAT FACTOR: VERY HIGH VULNERABILITY

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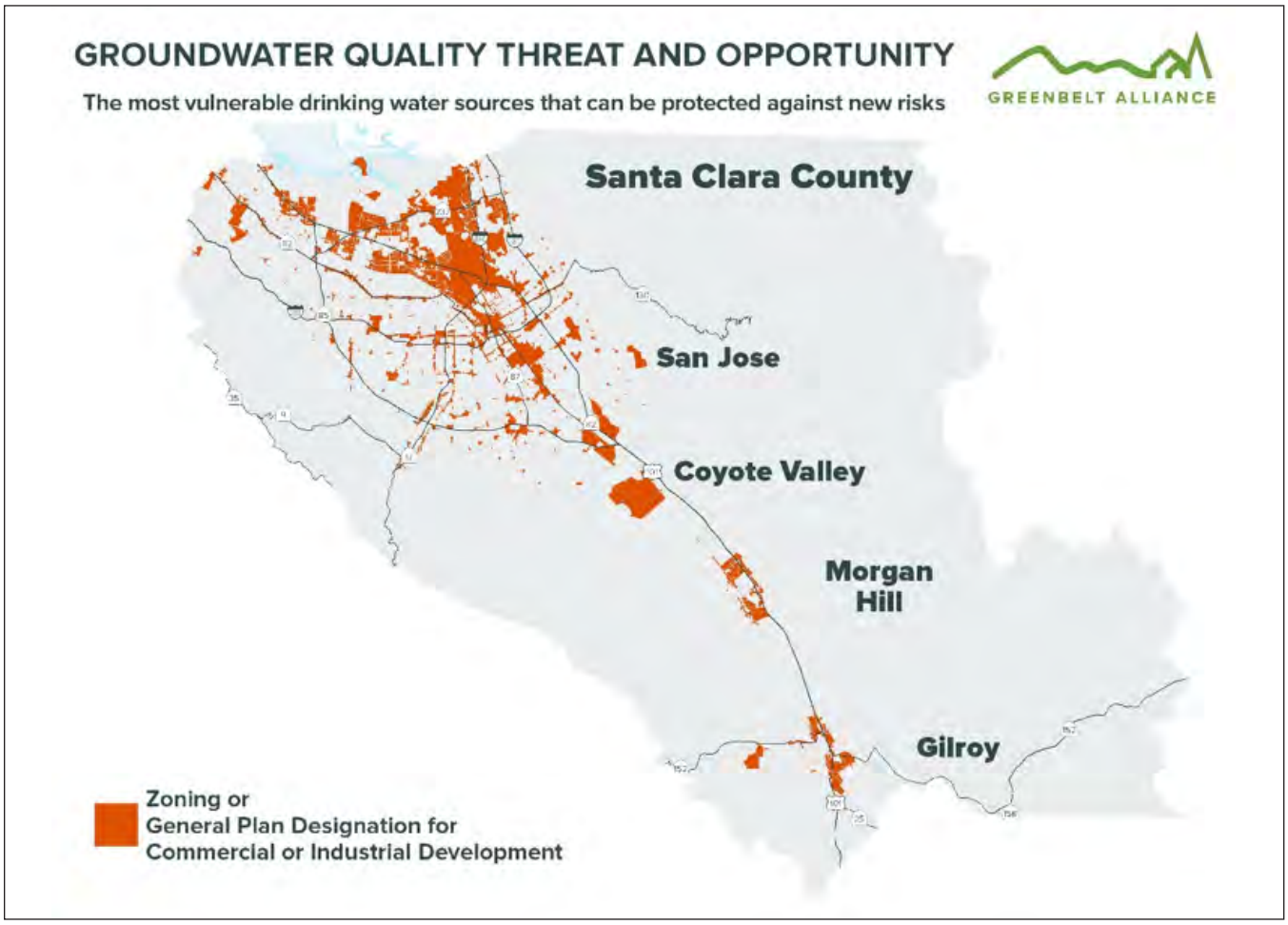
11/23/21

THREAT FACTOR: UNCONFINED ACQUIFER

Handout 2.7-B
11/23/21

THREAT FACTOR: ZONING OR GENERAL PLAN DESIGNATION FOR COMMERCIAL/INDUSTRIAL DEVELOPMENT



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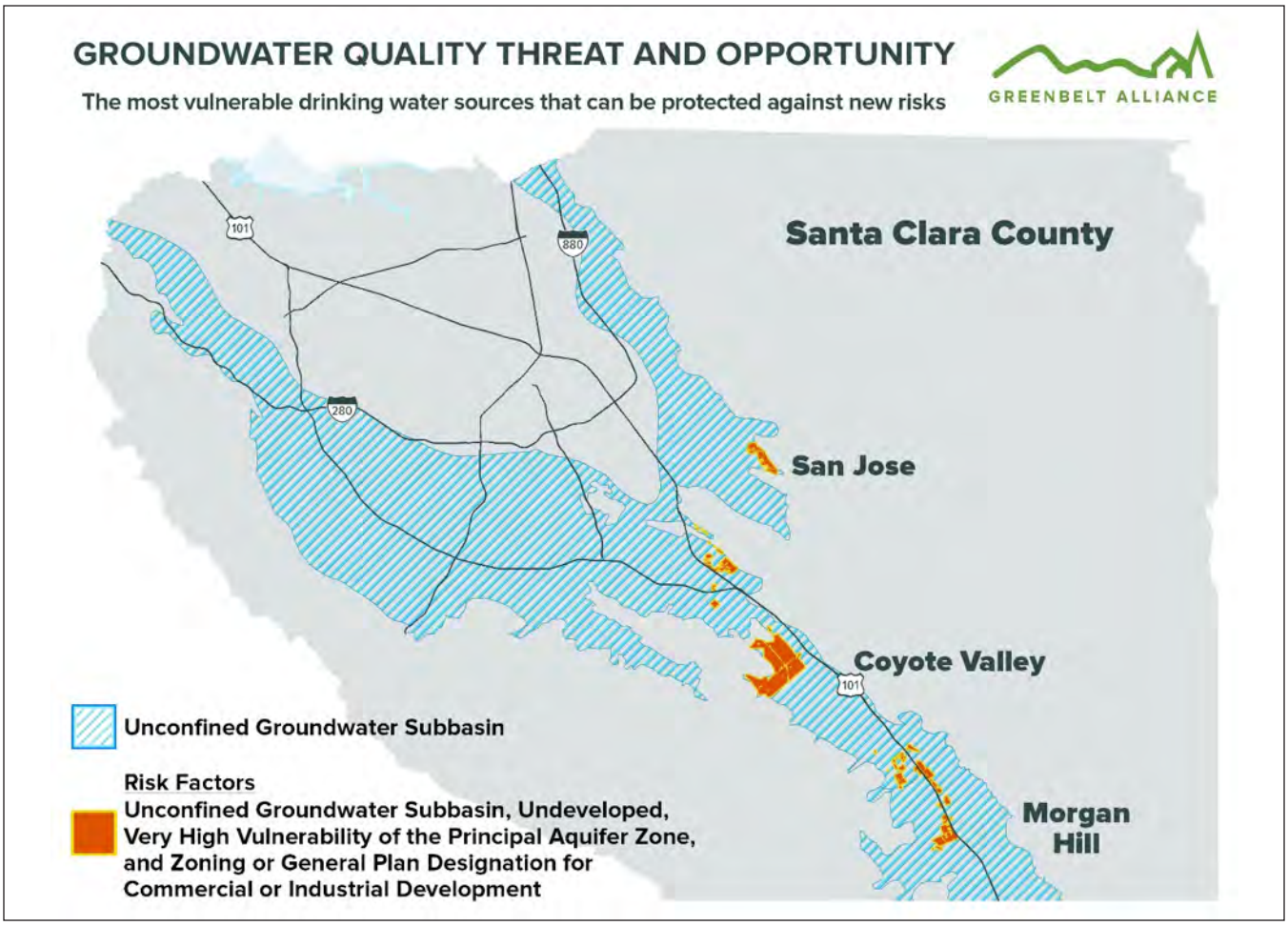
11/23/21

OPPORTUNITY FACTOR: UNDEVELOPED LAND

When putting the layers together into the final map, recopied below, the orange area shows where all four layers overlap. The unconfined aquifer is also shown to provide context that a relatively small part of that aquifer provides the best place to focus protection efforts for the combined threat and opportunity.

As described in the text, several additional reasons not analyzed in this mapping exercise demonstrate that the feasibility of protecting Coyote Valley exceeds that of the other areas mapped in orange.



ENDNOTES

1 Contamination of the creeks, a significant biological issue in addition to drinking water concerns, could come from a surface spill and could also come from a groundwater plume leaking into a creek in Coyote Valley and then flowing north for miles along Coyote Creek.

2 In theory, potentially responsible parties that caused the contamination would be required to pay for cleanup, but they cannot always be located and are not always financially capable of paying full cleanup costs.

3 In addition to the above examples, Southern Santa Clara County also experiences some groundwater nitrate contamination from agricultural activities. This contamination, a separate issue from industrial contamination, has been addressed to manageable levels and could be further managed with land use protections in Coyote Valley that still allow appropriate agricultural use.

4 Currently, the Vulnerability Analysis does not distinguish between groundwater vulnerability caused by overlying property and vulnerability of the underlying groundwater within a parcel regardless of the cause. For small parcels, the easement would dramatically affect vulnerability caused by the parcel, while only incrementally affecting the vulnerability of the groundwater itself. The revised analysis should distinguish between these two types of vulnerability so the benefit of the easement will be recognized.

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Andrea Mackenzie, General Manager
Alex Kennett, District 1
Mike Flaugher, District 2
Helen Chapman, District 3
Dorsey Moore, District 4
Shay Franco-Clausen, District 5
Mike Potter, District 6
Kalvin Gill, District 7

November 19, 2021

Santa Clara Valley Water District
Vanessa De La Piedra, Groundwater Management Unit Manager

RE: 2021 Draft Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Dear Ms. De La Piedra,

On behalf of the Santa Clara Valley Open Space Authority (Authority), thank you for the opportunity to provide comment on Valley Water's Draft Groundwater Management Plan (Draft Plan).

The Open Space Authority is a public, independent special district created by the California State Legislature in 1993 to conserve the natural environment, support agriculture, and connect people to nature by protecting open spaces, natural areas, and working farms and ranches for future generations.

Valley Water serves a critical role as our Groundwater Sustainability Agency (GSA), where it is responsible for delivering sustainable groundwater conditions in Santa Clara County. The Draft Plan is proposed to serve as the Groundwater Sustainability Plan update for Santa Clara County, which requires Valley Water to outline specific sustainable groundwater management criteria that avoid the six undesirable results outlined by the Sustainable Groundwater Management Act (SGMA), including the avoidance of depleted interconnected surface waters that supply water to Groundwater Dependent Ecosystems (GDEs) like wetlands, wetted stream channels, and riparian corridors.

We applaud Valley Water for its work to map GDEs in the Draft Plan and we are grateful for Valley Water's ongoing groundwater management actions that help maintain our aquifers in long-term balance. Nevertheless, the Draft Plan fails to include sustainable management criteria that avoid the depletion of interconnected surface waters, the only SGMA undesirable result not addressed in the Draft Plan, and one that is critical for Valley's Water's responsibility as a GSA, its mission to "Provide Silicon Valley safe, clean water for a healthy life, environment, and economy", and its Ends Policy E-4 "Water resources stewardship protects and enhances ecosystem health". Despite the immense efforts of Valley Water, we continue to observe the depletion of interconnected surface waters in our GDEs due to declines in groundwater levels. One particularly notable example being Fisher Creek and the Laguna Seca wetland complex in Coyote Valley, which underwent significant periods of drying during the 2012-2016 drought and are currently nearly completely dry as groundwater levels decline in the Coyote Valley.

As you know, the Authority, its conservation partners, and funders, have invested over $150million to date to permanently protect nearly 1,500 acres of land in Coyote Valley that encompass groundwater dependent ecosystems in and around Fisher Creek and the Laguna Seca wetland complex (**Exhibit A attached**). This includes more than $32 million in state grants from the California Natural Resources Agency (CNRA), Department of Conservation, Strategic Growth Council, Wildlife Conservation Board, and the State Coastal Conservancy. These lands will be subject of the Coyote Valley Conservation Areas Master Plan, an integrated restoration master plan process, which will enable large-scale restoration actions to begin within the next 3-5 years. In restoring Coyote Valley's groundwater-dependent ponds, wetlands, and riparian channels, our aim is to protect surface and groundwater quality and promote habitat conditions favorable to the recovery of rare, threatened, and endangered species such as California red-legged frog, California tiger salamander, and tri-colored blackbird among others.

Valley Water is a key partner of the Authority where its groundwater management actions are essential for the protection and restoration of groundwater dependent ecosystems in Coyote Valley. Given Valley Water's unique role, commitment to environmental stewardship and responsibilities under SGMA, we respectfully provide the following comments on the Draft Plan:

1. **Consider updating the Draft GSP's sustainability goal to specifically include sustainable supplies for all groundwater users (including the environment).**

   The Draft GSP identifies two sustainability goals: (1) "Manage groundwater to ensure sustainable supplies and avoid land subsidence", and (2) "Aggressively protect groundwater from the threat of contamination. While Valley Water has been able to provide long term balance of our aquifers, groundwater dependent ecosystems rely on groundwater supplies being maintained at or near the ground surface to sustain these ecosystems. Please consider updating Goal (1) to "Manage groundwater to ensure sustainable supplies *for all groundwater users, including environmental users of groundwater,* and avoid land subsidence".

2. **Include a new outcome measure and outcome measure lower thresholds that, if met, would avoid the depletion of interconnected surface waters.**

   The Draft GSP currently lacks sustainability criteria that directly addresses the depletion of interconnected surface waters. The Department of Water Resources' Alternative Assessment Staff Report: Santa Clara Subbasin (2-009.02) sent on July 17, 2019 stated that "…sustainable management criteria have not been established to avoid significant and unreasonable depletion of interconnected surface water." and "GSP Regulations specify that the minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.". Please consider adding a sixth outcome measure and lower threshold that would avoid depletion of interconnected surface waters.

3. **Consider developing an estimate of a sustainable yield or sustainable recharge that avoids undesirable results**

   The Authority wishes to support the long-term viability of land uses that are compatible with groundwater sustainability, and do not contribute to the depletion of the aquifer. The Draft Plan states "Valley Water does not manage to a particular value for sustainable yield, but instead manages groundwater to maintain sustainable conditions through annual operations and long-term water supply planning.". If Valley Water does not wish to provide a sustainable yield, please consider providing an estimate of sustainable recharge levels so that land use agencies and water users know what amount of water extraction is possible in areas like the Coyote Valley management area without exceeding Valley Water's recharge capabilities.

4. **Consider updating groundwater models to evaluate seasonal fluctuations in surface water groundwater interactions**

   The Draft GSP states "models are used to evaluate and forecast groundwater storage and water levels under various operational and hydrologic conditions. Maintaining calibrated models that can reasonably forecast groundwater conditions is an important part of Valley Water's comprehensive groundwater management strategy". It appears that some of Valley Water's groundwater models do not directly consider the interaction between groundwater and surface water and how that relates to the health of groundwater dependent ecosystems. Please consider updating your groundwater models to enable estimates of seasonal fluctuations in groundwater levels, since seasonal variability drives the health and sustainability of groundwater dependent ecosystems. The Authority is currently in the process of securing a consultant team for the Coyote Valley Conservation Areas Master Plan that will develop a SWAT-MODFLOW model of the Coyote Valley Management Area to better understand interconnected surface water behavior. We appreciate the Groundwater Unit's willingness to serve as a collaborator and technical adviser on this work and the Authority hopes this modeling could be useful for Valley Water's groundwater

condition forecasting and management activities that support groundwater dependent ecosystems.

5. **<u>Consider opportunities to pilot or implement voluntary actions that address groundwater demand, especially when sustainability indicators are not being met.</u>**

   Piloting tools, frameworks, and programs that support voluntary reductions in pumping could be an essential first step in addressing groundwater overdraft conditions without requiring regulatory action. Please consider potential next steps or opportunities to explore or implement programs like groundwater trading programs, farmland fallowing programs, ag irrigation efficiency grants, or voluntary agreements with well users to reduce pumping when sustainability indicators are not being met. The Authority and Peninsula Open Space Trust hold a conservation easement over the City of San Jose's land in Coyote Valley that requires the City consider reducing groundwater extraction from its municipal wells when they contribute to unsustainable groundwater conditions in Coyote Valley. We are in the process of determining the tools and frameworks that will be required to do this and appreciate the Valley Water Groundwater Unit's willingness to partner with us on this work and hope to develop new tools and monitoring frameworks that will make it easier for well operators to voluntarily reduce pumping when groundwater levels are trending in an unsustainable direction.

6. **<u>Add the Laguna Seca wetland complex and Fisher Creek as locations of known groundwater emergence.</u>**

   Figure 20 in the Draft GSP, "Likely Groundwater Emergent Areas in the Santa Clara Subbasin" does not include Fisher Creek or the Laguna Seca wetland complex, likely due to limitation in the resolution of GIS data that was used to identify those areas. However, the report recognizes Fisher Creek and Laguna Seca as locations of interconnected surface waters and groundwater dependent ecosystems. Please consider a manual update to Figure 20 to include Fisher Creek and Laguna Seca as groundwater emergent areas.

7. **<u>Add acknowledgment that Coyote Valley is a resource of statewide significance.</u>**

   a. AB-948 was approved by the Governor on September 27, 2019, authorizing the Authority to administer a newly created Coyote Valley Conservation Program, and declaring Coyote Valley is a resource of statewide significance. The bill requires that Coyote Valley to be acknowledged as an area of statewide significance in local planning documents developed or updated on or after January 1, 2020, affecting land use within Coyote Valley. Please add this acknowledgment given Coyote Valley land uses depend on groundwater, including the Authority's ongoing management and restoration of groundwater dependent ecosystems in and around Laguna Seca and Fisher Creek.

Thank you for your consideration.

Sincerely,

Andrea Mackenzie
General Manager

CC: Santa Clara Valley Open Space Authority Board of Directors

Exhibit A: Coyote Valley A Conserved Landscape- showing recently protected valley floor lands outlined in yellow

Handout 2.7-C
11/23/21

List of Changes to the Public Draft 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins

Topic	2021 GWMP		Description of Changes*
	Section	Page number	
Board action and outreach	Appendix A	A1, A2, A3	Added public notices, adoption resolution, and recent emails sent to interested stakeholders.
Demonstration of functional equivalency	Appendix B	B-3 to B-31	Added page numbers to the Alternative Element Guide to be consistent with Department of Water Resources (DWR) template.
Monitoring well details	Appendix K	K-2 to K-15	Updated the location tables with current latitude and longitude.
Coyote Valley	1.2	1-2	In response to comment letters received, added reference to AB-948 declaring Coyote Valley a resource of statewide significance.
High-priority basins	Executive Summary	ES-1	In response to comments received, added clarification that the high-priority Santa Clara and Llagas subbasins are not critically overdraft basins.
Comment letters	Appendix A	NA	Comment letters received and responses.
			* Not including minor editorial edits and corrections.

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December 6, 2021

Mr. Doug Muirhead
Morgan Hill, CA

Subject: Response to Comments on Valley Water's Draft 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Dear Mr. Muirhead:

This letter provides the Santa Clara Valley Water District (Valley Water) response to your November 7, 2021 comments regarding the draft 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins. We appreciate your detailed reading and review of the plan and your thoughtful comments. We made some changes to the 2021 plan based on your comments and will consider all comments in the next five-year update.

I understand that Valley Water staff (Vanessa De La Piedra and Jason Gurdak from our Groundwater Management Unit) had a phone call with you on November 19, 2021 to discuss your comments. Below are brief responses to your 15 numbered comments, many of which were discussed during the November 19 phone call.

1) The phrase "resistant to subsidence" is still accurate with respect to South County based on best available data. We will evaluate including additional text to further describe the potential for South County subsidence during the next five-year update.

2) Valley Water works to keep the community informed through regular Board of Directors (Board) and committee meetings, public meetings, social media, and direct mailings. We welcome and encourage more involvement from the public and continue to explore ways to increase public engagement. We engage the retailers directly because they have a big influence on water demand, and because we can offer treated surface water that reduces their demand on groundwater. Coordination with the retailers is also crucial to implement effective conservation measures through our community. We welcome your thoughts on ways to better engage the community in our groundwater management efforts.

3) Valley Water Board Resolution 18-04 provides a framework to regulate groundwater extraction under SGMA, if needed. The process does include potential "off-ramps" to elevate severe or challenging issues to the Board, but stresses continued collaboration with pumpers as the most effective approach to address worsening basin conditions. We concur with your comment that "increasing severity requires shorter response times" and believe the action Valley Water has taken in response to the current drought is a good example. As you are aware, due to the severity of projected groundwater conditions, our Board declared a water shortage emergency in June 2021 and Valley Water has accelerated our drought response through emergency water purchases, coordination with retailers and land use agencies to implement water restrictions and increases water conservation programs and outreach.

4) Our outcome measure is based on end-of-year (EOY) groundwater storage in the aquifers, rather than basin capacity. The "capacity" of the aquifers is much larger than the EOY storage outcome measure. Domestic wells are drawing from the same aquifers (principal) but municipal wells are generally deeper. Water levels and well depths vary greatly across the subbasins, which cover large areas. Rather than setting performance targets based on specific points, we use conservative targets for regional groundwater storage and take action as it starts to decline. This helps ensure reliability for all well users and actions taken during the last drought based on EOY groundwater storage confirmed this approach is reasonable for all well owners.

5) Missing well construction info is a common issue, not just in local aquifers but across the US. Construction info is often not available because the wells were drilled prior to regulations that require well construction information be shared with the State, or well logs are lost from older wells. Most wells in the Appendix D analysis are agricultural or domestic, and obtaining well depth would be infeasible because of the lack of well access agreements, the need to pull the pump to measure depth to bottom of the well, and/or the need to search for missing well logs. We are confident that using well depth from about 1,400 spatially distributed wells in the Llagas Subbasin (and about 2,300 in the Santa Clara Subbasin) provides a representative sample of the groundwater system.

6) The analysis that you reference demonstrates that during the 2012-2016 drought, which was one the worst droughts over the past 100 years, only 14 out 5,969 water supply wells went dry. These 14 wells were located along the basin margin, where groundwater storage is less and wells are more likely to go dry. The potential for wells going dry during a multi-year drought is a risk for any well owner, not just in our county, but the risk is very low in Santa Clara County. Because of Valley Water's extensive groundwater management actions, groundwater storage is sustainable and water levels recovered quickly after the drought. If groundwater storage drops below levels observed in 2014-2015, it is likely that as many (14) or more wells will go dry, likely around the margins of the basin. While the analysis did not quantify the risk or number of wells that might go dry as a function of drought magnitude or length, Valley Water's storage-based outcome measure helps ensure that wells will not go dry.

7) Yes, Valley Water works to forward any dry well reports we receive to the DWR reporting system and we also use DWR's system to identify whether any other dry wells have been reported by others in Santa Clara County.

8) Valley Water does not anticipate any legislative changes to the SGMA definitions of undesirable results due to state efforts to develop principles and strategies for groundwater management and drinking water well impacts. However, local agencies determine what conditions constitute undesirable results for their basins in coordination with basin stakeholders so drinking water well impacts can certainly be considered in establishing related thresholds.

9) Valley Water will evaluate if similar language is appropriate to describe water level fluctuations in the shallow and principal aquifers in the Llagas Subbasin during the next five-year update.

10) We acknowledge that the designation of "high-priority basin" could be misinterpreted. Therefore, throughout the Executive Summary and Plan we use plain language to describe that groundwater conditions are sustainable in Santa Clara County. For example, the first paragraph of the Executive Summary states that "Valley Water's comprehensive groundwater management

programs and investments have resulted in sustainable groundwater conditions for many decades and will ensure groundwater resources are sustainable far into the future."

11) The map referenced depicts recharge systems rather than individual ponds. Section 4.3.1 has a more detailed description and maps of the managed recharge facilities and refers to them as "recharge systems". Many of the recharge systems have multiple ponds. Appendix I lists all the recharge systems but doesn't list names for each of the 102 ponds. Valley Water will explore ways to clarify this during the next five-year update.

12) Point noted.

13) Thank you for the reference regarding the Loma Fire emergency response. There are times when Valley Water avoids supplying recharge facilities with local supplies due to turbidity, most often following large storm events. Madrone Channel is somewhat different than our recharge facilities because it also a flood channel. However, we're not aware of reduced releases into Madrone Channel due to turbidity. Valley Water will evaluate the need for additional analysis or explanation regarding potential wildfire impacts on managed recharge in the next five-year update.

14) There are FAA regulations and other limitations that prevent the airborne electromagnetic (AEM) surveys above populated areas. DWR plans on surveying the southern parts of the Llagas Subbasin as part of their North San Benito Subbasin flights. To our knowledge, the exact timing and spatial extent of those flights in Llagas Subbasin has not been released yet. However, we do look forward to receiving and using that data when it becomes available.

15) We have corrected the typos you identified.

Thank you for your comments and ongoing engagement that helps ensure continued sustainable groundwater supplies within Santa Clara County.

Sincerely,

Aaron Baker, P.E.
Chief Operating Officer
Water Utility Enterprise

cc: V. De La Piedra, J. Gurdak

Valley Water

Clean Water • Healthy Environment • Flood Protection

December 6, 2021

Brian Schmidt, Legislative Advocacy Director
Green Foothills

Subject: Response to Comments on Valley Water's Draft 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Dear Mr. Schmidt:

This letter provides the Santa Clara Valley Water District (Valley Water) response to the November 19, 2021 Green Foothills comment letter on Valley Water's draft 2021 Groundwater Management Plan (Plan) for the Santa Clara and Llagas Subbasins. We appreciate Green Foothills review of the Plan and share your commitment to protecting natural resources in the Coyote Valley and throughout Santa Clara County. We believe the Plan demonstrates continued sustainable conditions for all beneficial uses of groundwater within the Santa Clara and Llagas subbasins.

Given your stated support of the comments and recommendations from the Santa Clara Valley Open Space Authority (Open Space Authority), we encourage you to review Valley Water's attached response to their comments. We acknowledge your wish to emphasize and expand on the Open Space Authority's seventh comment regarding the importance of the Coyote Valley area.

Valley Water has added language in Section 1.2 (Description of Plan Area) of the Plan to note that Coyote Valley is a unique landscape and resource of statewide significance, including reference to AB-948. As noted in sections 5.3 (Basin Management Strategies) and 6.2.5 (Coordination with Land Use Agencies), Valley Water continues to work with land use and regulatory agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination. The City of San Jose, Santa Clara County, and the Open Space Authority continue to be key partners in ensuring groundwater protection in the Coyote Valley and other vulnerable groundwater recharge areas.

Thank you again for your comments and support for continued sustainable groundwater supplies within the Coyote Valley and Santa Clara County.

Sincerely,

Aaron Baker, P.E.
Chief Operating Officer
Water Utility Enterprise

cc: V. De La Piedra, J. Gurdak

Attachment: Valley Water Response to Open Space Authority Comments

December 6, 2021

Andrea Mackenzie
General Manager
Santa Clara Valley Open Space Authority

Subject: Response to Comments on Valley Water's Draft 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Dear Ms. Mackenzie:

This letter provides the Santa Clara Valley Water District (Valley Water) response to the November 19, 2021 Santa Clara Valley Open Space Authority (Authority) comment letter on Valley Water's draft 2021 Groundwater Management Plan (Plan) for the Santa Clara and Llagas Subbasins.

We appreciate the Authority's review of the Plan and share your commitment to environmental stewardship. The 2021 Plan is the first update to Valley Water's 2016 Alternative to a Groundwater Sustainability Plan (Alternative), which was approved by the California Department of Water Resources (DWR). The approved Alternative and the 2021 Plan continue to demonstrate that groundwater is sustainable throughout the Santa Clara Subbasin, including the Coyote Valley. The Plan advances our understanding of groundwater dependent ecosystems (GDEs) and interconnected surface water, two topics of key interest to the Authority. We look forward to ongoing collaboration with the Authority as we continue to refine that understanding during Plan implementation and development of the next five-year update.

Below, we respectfully offer responses to the Authority's letter, including the seven numbered comments.

Your letter mentions the drying of Fisher Creek and Laguna Seca during the 2012–2016 drought and the current drought as an example of the depletion of interconnected surface water due to declines in groundwater levels. The Sustainable Groundwater Management Act (SGMA) is clear that declining groundwater levels during a drought do not constitute an undesirable result if they are offset by increases in other periods. All beneficial users, including well owners and the environment, are challenged by drought due to scarce water supplies. Groundwater levels in Coyote Valley (and throughout Santa Clara County) certainly declined during the 2012–2016 drought. However, because of Valley Water's groundwater management activities and drought response, they quickly recovered in 2015 and 2016 and remained stable until the most recent drought.

Valley Water's proactive response to the current drought aims to minimize the impacts of drought, and we expect groundwater and surface water levels to quickly recover once hydrologic conditions improve. In accordance with the goals of SGMA and demonstrated by our approved Alternative, groundwater in Coyote Valley and other management areas in Santa Clara County are sustainable and in long-term balance due to Valley Water activities.

<u>OSA Comment 1</u>: Consider updating the Draft GSP's sustainability goal to specifically include sustainable supplies for all groundwater users (including the environment).

Chapter 5 of the Plan describes two sustainability goals related to groundwater supply reliability and protection that are intentionally aligned with the language in Board of Directors Ends Policy E-2. The approved Alternative and the 2021 Plan demonstrate that Valley Water has continued to meet the two sustainability goals of managing groundwater to ensure sustainable supplies and avoid land subsidence and to aggressively protect groundwater from the threat of contamination. Sustainable groundwater supplies benefit all uses within Santa Clara County, including environmental, agricultural, domestic, municipal, and industrial. During the next five-year update, Valley Water will evaluate the need for additional information on the various uses of groundwater, including environmental uses.

<u>OSA Comment 2</u>: Include a new outcome measure and outcome measure lower thresholds that, if met, would avoid the depletion of interconnected surface waters.

There are important distinctions between an Alternative and a GSP, and under SGMA regulations, Alternatives are not required to have the same format or content as GSPs. DWR approved Valley Water's Alternative, finding it meets the objectives of SGMA, and the 2021 Plan addresses all related DWR comments. Valley Water respectfully disagrees with the need to include a new outcome measure and associated lower threshold about the depletion of interconnected surface waters.

The explanation of Comment 2 includes quotes from DWR's Alternative Assessment Staff Report: Santa Clara Subbasin (2-009.02) sent to Valley Water on July 17, 2019. This 2019 Staff Report was part of DWR's evaluation process that concluded with the 2016 Plan being approved as an Alternative. The quotes from the DWR Staff Report in Comment 2 are taken out of context and misrepresent the meaning of DWR's Staff Report. Contrary to Comment 2, the DWR Staff Report agreed with the 2016 Plan conclusion that an outcome measure for the depletion of interconnected surface water is not applicable.

Consistent with our environmental stewardship mission, Valley Water has a vested interest in healthy streams and ecosystems, and our operations help support the environment. Interactions between groundwater and surface water are complex and dynamic, and the 2021 Plan provides a lot of additional information on interconnected surface water and GDEs in local basins. Best available data does not indicate any significant or unreasonable impacts to interconnected surface water and the 2021 Plan recommends additional work to continue to better understand groundwater/surface water interactions. Valley Water looks forward to our continued partnership with the Authority as we further explore this important issue.

<u>OSA Comment 3</u>: Consider developing an estimate of a sustainable yield or sustainable recharge that avoids undesirable results.

The 2021 Plan confirms Valley Water's reliance on a groundwater storage-based outcome measure (see section 5.4.1) rather than sustainable yield helps ensure sustainable groundwater conditions. Depending on the hydrologic conditions and operational constraints, Valley Water manages the recharge program and water use to achieve the storage-based outcome measure. By using a storage-based outcome measure, we can manage accordingly for variability in the inputs (recharge) and outputs (discharge) to maintain sustainable groundwater conditions in Coyote Valley and other areas of the basins. Valley Water has managed groundwater storage to remain well above the outcome measure except during drought years. As noted previously, SGMA recognizes that groundwater levels and storage will decline during droughts but focuses on ensuring local agencies can manage basins to ensure recovery and long-term balance. Coyote Valley and other groundwater management areas in Santa Clara County are in long-term balance due to Valley Water activities.

<u>OSA Comment 4</u>: Consider updating groundwater models to evaluate seasonal fluctuations in surface water groundwater interactions

Valley Water's groundwater models can simulate groundwater storage and fluctuations in groundwater levels. We plan to improve our understanding of and ability to simulate groundwater and surface water interaction. The 2021 Plan lists several recommendations that are consistent with Comment 4. For example, please see the recommendations 4b and 4c from section 8.3:

- Continue to identify and implement modeling improvements to enhance simulation capabilities, including groundwater storage estimates and sea-level rise impacts on seawater intrusion.
- Continue to improve understanding of surface water/groundwater interaction. Expand on Valley Water's 2018 differential gauging study to include additional time periods, hydrologic conditions, and methods, as appropriate.

We look forward to collaborating on the Authority's efforts to better understand the behavior of interconnected surface water.

<u>OSA Comment 5:</u> Consider opportunities to pilot or implement voluntary actions that address groundwater demand, especially when sustainability indicators are not being met.

Valley Water continues our efforts to expand water conservation (including agricultural efficiency) and recycling, which help to reduce long-term groundwater demand. We have established a Water Shortage Contingency Plan (WSCP) and take action to proactively reduce groundwater demand during droughts. The groundwater storage outcome measure and lower threshold in the 2021 Plan are directly tied to the WSCP levels. Valley Water has taken strong action during the current drought to minimize water supply impacts to groundwater and the community. Due to the severity of projected groundwater conditions, our Board declared a water shortage emergency in June 2021. We've also accelerated our drought response through emergency water purchases, coordination with retailers and land use agencies to implement water restrictions, and increased water conservation programs and outreach.

Through our Water Supply Master Plan, Valley Water explores potential projects such as land fallowing, as well as investments that may be needed to ensure future water supply reliability. We will continue to explore programs and actions that support sustainable groundwater and look forward to partnering with the Authority and others on these efforts.

<u>OSA Comment 6</u>: Add the Laguna Seca wetland complex and Fisher Creek as locations of known groundwater emergence.

As stated in the 2021 Plan (Section 8.3 Recommendations and Appendix G), Valley Water plans on revising and updating GDE and groundwater emergence maps as new information becomes available during each five-year update cycle. The 2021 Plan does identify much of Laguna Seca and Fisher Creek as GDEs.

<u>OSA Comment 7:</u> Add acknowledgment that Coyote Valley is a resource of statewide significance.

Valley Water has added language in Section 1.2 (Description of Plan Area) of the Plan to note that Coyote Valley is a unique landscape and resource of statewide significance, including reference to AB-948.

Thank you again for your comments. We look forward to ongoing collaboration to ensure continued sustainable groundwater conditions that support all beneficial uses within Santa Clara County.

Sincerely,

Aaron Baker, P.E.
Chief Operating Officer
Water Utility Enterprise

cc: V. De La Piedra, J. Gurdak

Appendix A – Board Action and GWMP Outreach

A2. GWMP Outreach – Public Notices

Newspaper : The Mercury News
Issue Date : 11/07/2021
Advertiser : SANTA CLARA VALLEY WATER DISTR
Ad Number : 6622706

EDUCATION

Magnet school project takes flight to help save monarchs

By Apala G. Egan
Correspondent

Kate Moody and Matt Jarrett, teachers at Steindorf STEAM Magnet School, are helping save monarch butterflies with the help of their second-grade students. They began the effort about four years ago as part of a project-based learning program.

"The students built a butterfly garden by the front of the school," Moody said. "It is a project they love. Kids love to see butterflies coming back into the community. It is exciting for the staff as well."

The students planted milkweed to attract the butterflies, which lay eggs on the plant. To increase the dwindling monarch butterfly population in San Jose's Cambrian area, the second graders also planted milkweed seeds in city parks such as Doerr Park and Houge Park. They handed out packets of milkweed seeds to parents in the Cambrian Union School District, which enrolls students from Campbell.

The U.S. Fish and Wildlife Service has announced that the monarch is a candidate for the Endangered Species Act. More than beautiful, monarch butterflies pollinate many types of wildflowers while feeding on nectar.

"This is a perfect example of what we do and how we solve real-world problems through project-based learning," Steindorf Principal Lisa MacFarland said.

Since Steindorf is a STEAM school, MacFarland said, "art has been integrated in many ways during the years with this project. One example is learning about symmetry by painting half a butterfly and then folding the paper. Another is creating 3D caterpillars in our Makerspace."

Students also designed and created the signs that are hanging in the garden.

Moody said students' efforts have paid off over time.

"We have had daily sightings of monarchs and found at least 20 eggs that have been laid in our garden and hallways," she said.

ENVIRONMENT

State senator pushes for California to reach zero emissions by 2035

By Olivia Wynkoop
Bay City News Foundation

State Sen. Josh Becker, D-San Mateo, announced his new legislative initiatives for a cleaner California during the United Nations Climate Conference, one of which calls on state government operations directly to go carbon neutral.

California already has a goal to meet carbon neutrality for its economy by no later than 2045, based on then-Gov. Jerry Brown's executive order in 2018. That means all residents and companies in the state would adjust to eco-friendly vehicles, energy options and conservation methods in production.

Becker's new legislation, which will be introduced in January when the Legislature reconvenes, would push for government operations to get to zero greenhouse gas emissions by 2035, 10 years earlier than the statewide goal.

"If we are going to ask the entire state to achieve net zero, shouldn't the government lead by example and show how to get to zero before asking everyone else to do it?" Becker asked in a news release.

Becker's hope is that this bill could encourage California to kickstart progress by trying out zero-emission operations.

"The state could — and should — lead on these issues by developing clear plans for how the state government will get to net-zero emissions within its own operations by being an early adopter of the necessary technologies that will ultimately be needed by the rest of the state," Becker said. He also wants to make reforms to "Build Clean Faster" to build up essential, environmentally-friendly projects and infrastructure at a quick pace.

"We cannot let business as usual, with all that red tape, prevent us from doing what must be done," he said. "It's time that we stop paying lawyers to fight about these projects and start paying workers to get them built.

PUBLIC HEARING NOTICE

2021 GROUNDWATER MANAGEMENT PLAN FOR SANTA CLARA AND LLAGAS SUBBASINS

Valley Water

Who: **Santa Clara Valley Water District**

What: **Public Hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins**

When: **Tuesday, November 23, 2021, 6:00 p.m.**

Where: **Zoom Teleconference - https://valleywater.zoom.us/j/87901362801**

The Santa Clara Valley Water District (Valley Water) invites you to a Public Hearing on the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins. If adopted by the Board of Directors, it will be submitted to the California Department of Water Resources by January 1, 2022 as an update to the approved alternative to a groundwater sustainability plan for these basins pursuant to the Sustainable Groundwater Management Act (SGMA).

The Santa Clara and Llagas groundwater subbasins span nearly 400 square miles in Santa Clara County. The subbasins underlie the valley floor and extend from the county boundaries with San Mateo and Alameda counties in the north, to the Santa Clara/San Benito County boundary in the south. The 2021 GWMP, which describes Valley Water goals, strategies, activities, and metrics to ensure continued groundwater sustainability, is available at: *https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable.*

This meeting is being held in accordance with the Brown Act, as currently in effect. Valley Water's offices are closed to the public. The 6:00 p.m. November 23, 2021 public hearing will be held during a virtual Board Meeting accessible to the public at Zoom link *https://valleywater.zoom.us/j/87901362801.*
Document(s) associated with this hearing are available for public inspection at *www.valleywater.org.*

For more information, contact Jason Gurdak, Senior Water Resources Specialist, at 408-630-2971.

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AVISOS IMPORTANTES
Esta reunión se lleva a cabo de acuerdo con la Ley Brown (Brown Act). Las oficinas del Valley Water están cerradas al público. La audiencia pública se llevará a cabo durante una reunión de la Junta virtual a la que el público puede acceder a través del link de Zoom de arriba. Los documentos asociados a esta audiencia están disponibles para la revisión del público en www.valleywater.org. Valley Water, en cumplimiento con la Ley de Estadounidenses con Discapacidades (ADA), solicita que las personas que requieran adaptaciones especiales para acceder o participar de las reuniones de la Junta de Valley Water se comuniquen con el secretario de la oficina de la Junta al (408) 630-2711, al menos 3 días hábiles antes de la reunión programada de la Junta, para asegurarse de que el personal del Distrito pueda ayudarlas. Se realizarán esfuerzos razonables para proveer adaptaciones para las personas con discapacidades.

THÔNG BÁO QUAN TRỌNG
Cuộc họp này sẽ được tổ chức theo Đạo luật Brown. Các văn phòng của Valley Water hiện đang đóng cửa không tiếp dân. Phiên điều trần công khai sẽ được tổ chức trong Cuộc Họp Hội Đồng Quản Trị trực tuyến và công chúng có thể truy cập vào theo liên kết Zoom ở trên. Tài liệu liên quan đến phiên điều trần này có thể truy cập để kiểm tra công khai tại www.valleywater.org. Theo Đạo Luật Người Mỹ Khuyết tật (ADA), Valley Water yêu cầu những cá nhân cần sự hỗ trợ đặc biệt để truy cập và/hoặc tham gia vào các cuộc họp Hội Đồng Quản Trị Của Cục Nước xin hãy liên hệ với Thư ký văn phòng Hội Đồng Quản Trị theo số (408) 630-2711 ít nhất 3 ngày làm việc trước khi cuộc họp Hội Đồng Của Cục Nước diễn ra theo lịch để đảm bảo rằng nhân viên của Cục Nước có thể hỗ trợ quý vị. Chúng tôi sẽ thực hiện những nỗ lực hợp lý để hỗ trợ người khuyết tật.

重要通知
本次会议遵循布朗法案举行。 Valley Water 办公室不对公众开放。 公众听证会将在理事会线上会议期间举行，公众可通过以上的Zoom链接访问参与。 公众可在此获取与本次听证会相关的文件：www.valleywater.org.按照《美国残疾人法案》（ADA）规定，Valley Water 要求出席或参与理事会会议的有特殊住宿需要的个人，在理事会会议之前至少3个工作日致电（408）630-2711，与理事会办公室工作人员联系，以确保相关员工可以为您提供帮助。我们会做出合理的努力，帮助解决残障人士的需求。

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COMMUNITY MEETING
Tuesday, Nov. 9
10:00 a.m.
Double D's Sports Grille
354 N. Santa Cruz Ave.
Los Gatos, CA 95030

COMMUNITY MEETING
Wednesday, Nov. 10
10:00 a.m.
Jack Holder's Restaurant
3153 Meridian Ave., Suite 20
San Jose, CA 95124

COMMUNITY MEETING
Wednesday, Nov. 10
10:00 a.m. & 2:00 p.m.
Aloft Hotel
840 E. El Camino Real
Mountain View, CA 94040

COMMUNITY MEETING
Thursday, Nov. 11
10:00 a.m.
SHC University
Medical Group
50 E. Hamilton Ave.
Training Room, 2nd Floor
Campbell, CA 95008

WEBINAR
Friday, Nov. 12
10:00 a.m.

WEBINAR
Saturday, Nov. 13
10:00 a.m.

RSVPs are required for in-person meetings. To register, or for a complete list of meetings:
Visit www.EssenceHealthcare.com/Seminars or Call **1-855-443-4257** (TTY: 711)*

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For accommodations of persons with special needs at meetings, call 1-855-443-4257 (TTY: 711).

Y0027_22-449_C TMN_11.07

Newspaper : The Mercury News
Issue Date : 11/17/2021
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OAKLAND

Coliseum site planning moves forward

By Annie Sciacca
asciacca@bayareanewsgroup.com

OAKLAND » While negotiations over the Oakland A's planned waterfront ballpark continue to get most of the attention, the City Council is poised to move forward today with plans to redevelop the vast Coliseum site that's been the team's home for decades.

The council could enter into an exclusive negotiating agreement with one of two groups that are competing for the chance to redevelop the 100-acre property off Hegenberger Road.

The chosen group then would be given a year or 18 months to work out a deal to either buy or lease the city's share of the Coliseum Complex site — the A's own the other half — and redevelop it into a mixed-use project, according to a city memo.

At the end of that period, the city could choose to extend the negotiations, sign a development agreement to set the course for construction or end the talks and hit the reset button with other development groups.

Although the city's staff has indicated there's no rush to enter an agreement, Vice Mayor Rebecca Kaplan is urging her council colleagues to act now in determining the Coliseum's fate.

"It is located in East Oakland, which has historically been underinvested and harmed by past decisions that undermined key community needs," Kaplan wrote. "These communities are in danger of further disinvestment with the uncertainty of the Coliseum Complex's future and risk losing jobs and economic opportunities if the site is not revived in a positive and effective way."

The two groups courting the city want to transform the swath of property — which includes the Coliseum stadium that currently houses the A's and once hosted the Oakland Raiders, and the Oakland Arena that once was home to the Golden State Warriors, as well as the parking lots around it — into an oasis containing different mixes of sports fields or arenas, affordable homes, office buildings, businesses and maybe a museum or two.

One group, the African American Sports and Entertainment Group, or AASEG, includes founding partner Ray Bobbitt, former Oakland city manager Robert Bobb, developer Alan Dones, sports agent Bill Duffy and consultant Shonda Scott in partnership with Black-owned investment firm Loop Capital. The group previously announced its intention to reel in a Women's National Basketball Association expansion team run by Black owners to play in the Arena, and recently revealed that 14-year WNBA veteran Alana Beard would partner with it to lead that effort.

In interviews earlier this year, Bobbitt said AASEG also plans to build housing, office space, retail, a sports and entertainment hall of fame, and a stadium for an African American-owned NFL team at the Coliseum stadium. The group's website also touts its vision of producing a college satellite campus or other academic center focused on sports and entertainment business to the site.

The other group is led by former A's star pitcher and Oakland native Dave Stewart and certified player agent Lonnie Murray. They're proposing to refurbish the Oakland Arena for concerts and music production, to add youth sports and recreation fields, and to build housing, a museum or library, a business incubator, office space, retail and restaurants.

The group recently announced it is partnering with Elaine Brown, a former leader of the Black Panther Party and currently the CEO of Oakland & the World Enterprises. According to its website, that company aims to build "for-profit businesses for cooperative ownership by formerly incarcerated and other people facing extreme barriers to economic survival and support those businesses to profitability."

The group has also pledged to pay upfront a full purchase price of $115 million for the city's share of the property.

Whichever group is chosen likely would have to partner with the Oakland A's, which signed an agreement to buy a 50% share of the Coliseum site from Alameda County two years ago for $85 million.

The A's have been tight-lipped about their plans for the property. When they bought it, the A's said their intent was to redevelop the Coliseum site into housing, retail, office and research campus space. They then offered to buy the city's share so they could become the master developer of the entire property, but the city refused.

A team spokesperson did not immediately answer a request for comment on the A's current plans for the site or willingness to work with whichever group co-owns or leases a share of the property. But so far, team President Dave Kaval and Major League Baseball officials have been adamant that the A's won't continue playing at the Coliseum after the lease expires in 2024 unless the new ballpark is under construction.

The A's are still negotiating with the city to build a 35,000-seat waterfront ballpark, about 3,000 homes, hotel rooms, office space and an entertainment complex at Howard Terminal, near Jack London Square. The team is also exploring sites in Las Vegas and southern Nevada for a potential home.

In cautioning the council against choosing a development group now, city staff noted in a memo that more time is needed to assess each group's credentials and finances.

The staff recommends waiting until January to take action. Today's council meeting starts 1:30 p.m. and can be watched online at https://oakland.legistar.com/calendar.aspx.

PUBLIC HEARING NOTICE

2021 GROUNDWATER MANAGEMENT PLAN FOR SANTA CLARA AND LLAGAS SUBBASINS

Valley Water

Who: **Santa Clara Valley Water District**

What: **Public Hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins**

When: **Tuesday, November 23, 2021, 6:00 p.m.**

Where: **Zoom Teleconference - https://valleywater.zoom.us/j/87901362801**

The Santa Clara Valley Water District (Valley Water) invites you to a Public Hearing on the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins. If adopted by the Board of Directors, it will be submitted to the California Department of Water Resources by January 1, 2022 as an update to the approved alternative to a groundwater sustainability plan for these basins pursuant to the Sustainable Groundwater Management Act (SGMA).

The Santa Clara and Llagas groundwater subbasins span nearly 400 square miles in Santa Clara County. The subbasins underlie the valley floor and extend from the county boundaries with San Mateo and Alameda counties in the north, to the Santa Clara/San Benito County boundary in the south. The 2021 GWMP, which describes Valley Water goals, strategies, activities, and metrics to ensure continued groundwater sustainability, is available at: *https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable.*

This meeting is being held in accordance with the Brown Act, as currently in effect. Valley Water's offices are closed to the public. The 6:00 p.m. November 23, 2021 public hearing will be held during a virtual Board Meeting accessible to the public at Zoom link *https://valleywater.zoom.us/j/87901362801.*
Document(s) associated with this hearing are available for public inspection at *www.valleywater.org.*

For more information, contact Jason Gurdak, Senior Water Resources Specialist, at 408-630-2971.

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THÔNG BÁO QUAN TRỌNG
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重要通知
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Creating our Wish Book and Share the Spirit stories each year is a labor of love. This year you can get an insider look at how we determine who becomes the subject of a story, how reporters and photographers capture the essence of the situation, and why these profiles change lives. Join us to find out how Bay Area News Group puts together our Wish Book and Share the Spirit sections.
Register FREE at mercurynews.com/events
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Bay Area News Group

Appendix A – Board Action and GWMP Outreach

A3. GWMP Outreach – Emails to Interested Stakeholders

From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Monday, November 22, 2021 10:25 AM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: Valley Water public hearing on the 2021 Groundwater Management Plan, Tuesday November 23, 2021 at 6:00 pm

Dear Interested Stakeholders,

Valley Water Board of Directors is holding a public hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins on Tuesday November 23, 2021 at 6:00 pm via Zoom.

The meeting agenda (see item 2.7) and Zoom link are available here:
https://scvwd.legistar.com/View.ashx?M=A&ID=905589&GUID=61A8C04A-A3AA-4ED7-906A-2A3A7408DFED

If you have questions, please contact Jason Gurdak, Senior Water Resources Specialist, at jgurdak@valleywater.org.

From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Tuesday, November 16, 2021 8:49 AM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: Public hearing on the 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins - Tuesday Nov 23, 2021 at 6:00 pm

Dear Interested Stakeholders,

Valley Water is holding a public hearing regarding the 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas Subbasins on Tuesday November 23, 2021 at 6:00 pm via Zoom.

The 2021 GWMP describes Valley Water goals, strategies, activities, and metrics to ensure continued groundwater sustainability. The plan serves as the first required five-year update to Valley Water's 2016 GWMP, which was approved by the state for compliance with the Sustainable Groundwater Management Act (SGMA).

The Board meeting agenda and Zoom link are available here:
https://scvwd.legistar.com/View.ashx?M=A&ID=809844&GUID=31E7C50B-16FA-4F76-9E5D-EBA93A2C40EB.

Additional information about Valley Water's activities as the Groundwater Sustainability Agency is available here:
https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist at jgurdak@valleywater.org or 408-630-2971.

From: Valley Water Groundwater Management
Sent: Friday, October 8, 2021 4:26 PM
To: GWMP@valleywater.org
Subject: Draft 2021 Groundwater Management Plan for the Santa Clara and Llagas subbasins posted for public review

Dear Interested Stakeholders,

Valley Water has completed the draft 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas subbasins to support continued compliance with the Sustainable Groundwater Management Act (SGMA). To view the completed draft, please visit: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

Written comments will be accepted until November 19, 2021 at 5:00 pm and should be submitted by email to:
Vanessa De La Piedra, Groundwater Management Unit Manager
Email: vdelapiedra@valleywater.org
Please use subject line "2021 GWMP Comments"

A public hearing on the 2021 GWMP is expected to be held at the Valley Water Board of Directors meeting on November 23, 2021. Valley Water will provide interested stakeholders with more information on meeting details, including instructions on how to submit written or oral comments for the public hearing.

The final 2021 GWMP will be submitted before January 1, 2022 to the California Department of Water Resources, in accordance with SGMA regulations.

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist, at jgurdak@valleywater.org or 408-630-2971.

From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Friday, September 24, 2021 1:17 PM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: SGMA update to Valley Water Board Committee on September 27, 2021

Dear Interested Stakeholders,

Valley Water staff will provide a Sustainable Groundwater Management Act (SGMA) update to the Board's Water Conservation and Demand Management Committee (Committee) during the September 27, 2021 meeting, which begins at 11:00 am. This brief verbal update will include the five-year Alternative update for the Santa Clara and Llagas subbasins and the new Groundwater Sustainability Plan for the North San Benito Subbasin. The Committee meeting agenda and Zoom link are available here: https://www.valleywater.org/sites/default/files/WCaDMC-Agenda-09272021.pdf.

Additional information about Valley Water's activities as the Groundwater Sustainability Agency is available here: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist at jgurdak@valleywater.org or 408-630-2971.

From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Wednesday, August 11, 2021 2:59 PM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: Reminder: Public meeting on the Groundwater Management Plan for the Santa Clara and Llagas Subbasins; August 12, 2021, 5:30 to 6:30 pm

Dear Interested Stakeholders,

Please join us for a virtual public meeting on Thursday August 12, 2021 from 5:30 to 6:30 pm on the potential updates to our Groundwater Management Plan for the Santa Clara and Llagas Subbasins. These updates are required by the Sustainable Groundwater Management Act (SGMA) every five years and help ensure that groundwater in Santa Clara County continues to be sustainably managed.

Join the virtual meeting using either Zoom or Facebook:
https://valleywater.zoom.us/j/81818614491
Webinar ID: 818 1861 4491
Dial-in: 1(669)900-9128
Facebook.com/SCVWD
See the attached flyer for additional meeting details.

Additional information about Valley Water's activities as the Groundwater Sustainability Agency (GSA) is available here: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist at jgurdak@valleywater.org or 408-630-2971.

You're invited to our GROUNDWATER MANAGEMENT PLAN for CONTINUED SUSTAINABILITY public meeting!

Valley Water

Santa Clara County is in an extreme drought and everyone is urged to make water conservation a way of life. Valley Water is doing everything we can to ensure we provide safe, clean water to our community. That commitment involves protecting and replenishing local groundwater supplies to make sure we have a reliable water supply in years to come. Groundwater is an essential local water resource, providing nearly half of the water used in the county.

We want to hear from you!

Valley Water welcomes public feedback on the potential updates to our Groundwater Management Plan. As required by the state's Sustainable Groundwater Management Act (SGMA), Valley Water updates its Groundwater Management Plan every five years. These updates help ensure this important resource continues to be sustainably managed in the face of climate change and more severe droughts. Please join us for a virtual public meeting at 5:30 p.m. on August 12.

For more information on our groundwater management efforts, visit: **https://www.valleywater.org/your-water/where-your-water-comes/groundwater** or reach out to Senior Water Resource Specialist Jason Gurdak at (408) 630-2971 or JGurdak@valleywater.org.

Madrone Channel in Morgan Hill

When:
Thursday, August 12, 2021
5:30 P.M. to 6:30 P.M.

Where:
https://valleywater.zoom.us/j/81818614491
Webinar ID: 818 1861 4491
Dial-in: 1(669)900-9128
Facebook.com/SCVWD

About Valley Water

Valley Water effectively manages 10 dams and surface water reservoirs, three water treatment plants, an advanced water purification center, and a state-of-the-art water quality laboratory. Valley Water provides wholesale water and groundwater management services to local municipalities and private water retailers who deliver drinking water to homes and businesses. As the flood protection authority for Santa Clara County, Valley Water annually prepares creeks for winter rains through levee maintenance, sediment removal, bank repair and vegetation management.

Si habla español y tiene preguntas sobre el contenido de este mensaje por favor de comunicarse con José Villarreal al JVillarreal@valleywater.org o (408) 630-2879.

Nếu bạn nói tiếng Việt và có thắc mắc về nội dung của thông báo này, xin vui lòng liên hệ với Triet Trinh TTrinh@valleywater.org.

如果你說中文並對上述訊息有疑問, 請聯繫 Julia Tat, 電郵 JTat@valleywater.org, 或者電話: (408) 630-3168.

valleywater.org

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From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Tuesday, August 3, 2021 3:19 PM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: Public meeting on the Groundwater Management Plan for the Santa Clara and Llagas Subbasins; August 12, 2021, 5:30 to 6:30 pm

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We want to hear from you!

Valley Water welcomes public feedback on the potential updates to our Groundwater Management Plan. As required by the state's Sustainable Groundwater Management Act (SGMA), Valley Water updates its Groundwater Management Plan every five years. These updates help ensure this important resource continues to be sustainably managed in the face of climate change and more severe droughts. Please join us for a virtual public meeting at 5:30 p.m. on August 12.

For more information on our groundwater management efforts, visit: **https://www.valleywater.org/your-water/where-your-water-comes/groundwater** or reach out to Senior Water Resource Specialist Jason Gurdak at (408) 630-2971 or JGurdak@valleywater.org.

Madrone Channel in Morgan Hill

When:
Thursday, August 12, 2021
5:30 P.M. to 6:30 P.M.

Where:
https://valleywater.zoom.us/j/81818614491
Webinar ID: 818 1861 4491
Dial-in: 1(669)900-9128
Facebook.com/SCVWD

About Valley Water

Valley Water effectively manages 10 dams and surface water reservoirs, three water treatment plants, an advanced water purification center, and a state-of-the-art water quality laboratory. Valley Water provides wholesale water and groundwater management services to local municipalities and private water retailers who deliver drinking water to homes and businesses. As the flood protection authority for Santa Clara County, Valley Water annually prepares creeks for winter rains through levee maintenance, sediment removal, bank repair and vegetation management.

Si habla español y tiene preguntas sobre el contenido de este mensaje por favor de comunicarse con José Villarreal al JVillarreal@valleywater.org o (408) 630-2879.

Nếu bạn nói tiếng Việt và có thắc mắc về nội dung của thông báo này, xin vui lòng liên hệ với Triet Trinh TTrinh@valleywater.org.

如果你說中文並對上述訊息有疑問, 請聯繫 Julia Tat, 電郵 JTat@valleywater.org, 或者電話: (408) 630-3168.

valleywater.org

Clean Water • Healthy Environment • Flood Protection

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From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Friday, May 7, 2021 11:19 AM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: SGMA update to Valley Water Board Committee on May 10, 2021

Dear Interested Stakeholders,

Valley Water staff will provide a Sustainable Groundwater Management Act (SGMA) update to the Board's Water Conservation and Demand Management Committee (Committee) during the May 10, 2021 meeting, which begins at 11 am. This update will include progress and schedule for the five-year Alternative update for the Santa Clara and Llagas subbasins and the new Groundwater Sustainability Plan being developed for the North San Benito Subbasin. The Committee meeting agenda and Zoom link are available here: https://www.valleywater.org/sites/default/files/WCaDMC-Agenda-05102021.pdf.

Additional information about Valley Water's activities as the Groundwater Sustainability Agency is available here: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist at jgurdak@valleywater.org or 408-630-2971.

From: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Sent: Tuesday, April 27, 2021 2:11 PM
To: Valley Water Groundwater Management <Valley_Water_Groundwater_Management@valleywater.org>
Subject: Annual SGMA Report for the Santa Clara and Llagas Subbasins

Dear Interested Stakeholders,

This email is to inform interested parties about the Sustainable Groundwater Management Act (SGMA) 2020 Water Year Report for the Santa Clara and Llagas Subbasins, which was recently completed by Valley Water. SGMA requires Groundwater Sustainability Agencies to submit annual water year reports to the California Department of Water Resources (DWR) each April 1 following the adoption of a Groundwater Sustainability Plan (GSP) or Alternative. These reports provide information on groundwater conditions and implementation of the GSP or Alternative over the prior water year (October 1 to September 30).

The 2020 Water Year Report for the Santa Clara and Llagas Subbasins, which documents continued sustainable conditions, is posted to both the Valley Water and DWR websites at the following links:

- Direct link to the 2020 water year report on Valley Water's Sustainable Groundwater Management page: click here

- DWR SGMA GSP Alternative portal: https://sgma.water.ca.gov/portal/alternative/all

- Santa Clara Subbasin page, Section D Annual Report: https://sgma.water.ca.gov/portal/alternative/print/18
- Llagas Subbasin page, Section D Annual Report: https://sgma.water.ca.gov/portal/alternative/print/20

Additional information about Valley Water's activities as a Groundwater Sustainability Agency is available here: https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

If you have any questions, please contact Jason Gurdak, Senior Water Resources Specialist at jgurdak@valleywater.org or 408-630-2971.

Appendix A – Board Action and GWMP Outreach

A4. GWMP Outreach – List of Meetings Where the GWMP was Discussed

A4. GWMP Outreach – List of Meetings Where the GWMP was Discussed

Board of Directors Meetings

- November 23, 2021
- January 12, 2021

Board of Directors Water Conservation and Demand Management Committee Meetings

- October 25, 2021
- September 27, 2021
- August 30, 2021
- July 26, 2021
- May 10, 2021
- September 29, 2020

Stakeholder Meetings

- Meetings with Water Retailers – Water Supply and Groundwater Subcommittee

  - October 4, 2021
  - August 13, 2021
  - June 17, 2021
  - March 3, 2021
  - January 20, 2021
  - September 20, 2020
  - June 15, 2020

- Informational Public Meetings
  - August 12, 2021

Appendix A – Board Action and GWMP Outreach

A5. GWMP Outreach – Valley Water Website Information

Valley Water has managed groundwater resources in Santa Clara County since 1929, and conditions have been sustainable for many decades due to Valley Water's activities that protect and augment groundwater supplies. In 2014, Governor Brown signed the Sustainable Groundwater Management Act (SGMA) to promote the local, sustainable management of groundwater supplies. For basins designated as medium and high priority by the state, SGMA requires local Groundwater Sustainability Agencies (GSAs) to develop and implement Groundwater Sustainability Plans (GSPs) or Alternatives to achieve sustainability.

Local Groundwater Sustainability Agency (GSA)

SGMA lists Valley Water as the exclusive groundwater management agency within its statutory boundary, which includes all of Santa Clara County. Valley Water is the GSA for the Santa Clara and Llagas Subbasins (the primary basins in the county) and the small portions of the North San Benito Subbasin in Santa Clara County.

Groundwater Sustainability Plan (GSP) or Alternative

SGMA requires that GSAs prepare a GSP for all medium and high priority basins. Recognizing that groundwater is already well-managed in many areas, SGMA also allows specified Alternatives to a GSP. While GSPs must be completed by 2022 (or 2020 if the basin is in critical overdraft), Alternatives had to be submitted to the California Department of Water Resources (DWR) by January 1, 2017.

The 2016 Groundwater Management Plan for the Santa Clara and Llagas Subbasins (GWMP) describes Valley Water's groundwater sustainability goals, and the strategies, programs, and activities that support those goals. Following a public hearing, Valley Water's Board of Directors adopted the GWMP on Nov. 22, 2016. The GWMP was submitted to DWR as an Alternative on Dec. 21, 2016. On July 17, 2019, DWR approved the Alternative for both the Santa Clara and Llagas Subbasins, determining it satisfies the objectives of SGMA.

- Download the 2016 Groundwater Management Plan (https://s3.us-west-2.amazonaws.com/assets.valleywater.org/2016%20Groundwater%20Management%20Plan.pdf) (PDF 45 MB)

For the North San Benito Subbasin, Valley Water is coordinating with the San Benito County Water District (SBCWD) to develop a GSP by the 2022 deadline. Because the majority of this subbasin is in San Benito County, SBCWD is leading the GSP efforts.

Draft 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins (SGMA Alternative) now available for Public Review

SGMA requires GSAs to submit five-year updates to approved Alternatives, with the first update due by January 1, 2022. The update should describe whether implementation of the Alternative, including related projects and management actions, is meeting the sustainability goals in the basin.

Valley Water has completed the draft 2021 Groundwater Management Plan (GWMP) for the Santa Clara and Llagas subbasins.

- To view the completed draft 2021 Groundwater Management Plan (GWMP), please click on this link (https://fta.valleywater.org/dl/9dNFt2qdvT) (75 MB)

Written comments on the draft GWMP will be accepted until November 19, 2021 at 5:00 pm and should be submitted by email to:

- Vanessa De La Piedra, Groundwater Management Unit Manager
- Email: vdelapiedra@valleywater.org (mailto:vdelapiedra@valleywater.org)

A public hearing on the 2021 GWMP is expected to be held at the Valley Water Board of Directors meeting on November 23, 2021. Valley Water will provide interested stakeholders with more information on meeting details, including instructions on how to submit written or oral comments for the public hearing.

Groundwater Management Plan Public Meeting - August 12, 2021

Valley Water hosted a virtual meeting on August 12, 2021, to update the public on the potential updates to our Groundwater Management Plan. The meeting presentation and recording can be found here:

- Meeting Presentation (https://www.valleywater.org/sites/default/files/GWMPPresentationAug2021.pdf)
- Meeting Recording (https://youtu.be/uyXUb_A9fmo)

Annual Reporting to DWR for the Santa Clara and Llagas Subbasins

As required by SGMA, annual reports must be submitted to DWR by April 1 of each year for the previous water year (October 1 to September 30).

- Download the Water Year 2020 Report for the Santa Clara and Llagas Subbasins (https://s3.us-west-2.amazonaws.com/assets.valleywater.org/Water%20Year%202020%20Report%20for%20the%20Santa%20Clara%20and%20Llagas%20Subbasins.pdf) (PDF 12 MB)
- Download the Water Year 2019 Report for the Santa Clara and Llagas Subbasins (/sites/default/files/Water%20Year%202019%20Report%20for%20the%20Santa%20Clara%20and%20Llagas%20Subbasins.pdf) (PDF 3 MB)
- Download the Water Year 2018 Report for the Santa Clara and Llagas Subbasins (/sites/default/files/Water%20Year%202018%20Report%20for%20the%20Santa%20Clara%20and%20Llagas%20Subbasins.pdf) (PDF 4 MB)
- Download the Water Year 2017 Report for the Santa Clara and Llagas Subbasins (/sites/default/files/Water%20Year%202017%20Report%20for%20the%20Santa%20Clara%20and%20Llagas%20Subbasins.pdf) (PDF 4 MB)

Additional information about the Alternative and annual reporting is available on the DWR SGMA Alternative Portal for Santa Clara Valley Water District. (https://sgma.water.ca.gov/portal/alternative/print/18)

North San Benito Subbasin GSP

The North San Benito Subbasin is largely located within San Benito County, with small portions within Santa Clara County. Both San Benito County Water District (SBCWD) and Valley Water are GSAs for the North San Benito Subbasin, with SBCWD taking the lead on GSP development and Valley Water providing support and serving on the Technical Advisory Committee (TAC).

The Draft GSP is available on the SBCWD website: https://www.sbcwd.com/gsp-development/ (https://www.sbcwd.com/gsp-development/)

SBCWD is holding a Virtual Groundwater Workshop via Zoom to present the draft GSP to the public on Wednesday, August 4th 2021 from 4:00 to 6:00 pm. Details on how to join the Zoom workshop are available on the SBCWD website: https://www.sbcwd.com/zoom/ (https://www.sbcwd.com/zoom/)

Interested Parties

If you would like to receive information on groundwater management activities in the Santa Clara and Llagas Subbasins, including SGMA compliance, please email us at GWMP@valleywater.org (mailto:gwmp@valleywater.org).

If you would like to receive notifications on GSP development for the North San Benito Subbasin (including the Santa Clara County portion), please contact Barbara Mauro, SBCWD Board Clerk: bmauro@sbcwd.com (mailto:bmauro@sbcwd.com)

This webpage was last updated on August 2, 2021. For questions, please contact us at GWMP@valleywater.org (mailto:GWMP@valleywater.org).

Where Your Water Comes From

Groundwater

Sustainable Groundwater Management (/your-water/where-your-water-comes/groundwater/sustainable)
Groundwater Supply (/your-water/where-your-water-comes/groundwater/groundwater-supply)
Groundwater Quality (/your-water/where-your-water-comes/groundwater/groundwater-quality)
Groundwater Monitoring (/your-water/where-your-water-comes/groundwater/groundwater-monitoring)
Groundwater Studies (/your-water/where-your-water-comes/groundwater/groundwater-studies)

Groundwater Benefit Zone Study (/your-water/where-your-water-comes/groundwater/groundwater-benefit-zone-study)
Subsidence (/your-water/where-your-water-comes/groundwater/subsidence)
Free testing for domestic well owners (/your-water/where-your-water-comes/groundwater/free-testing-domestic-well-owners)
Certified Laboratories (/your-water/certified-laboratories)

Imported Water
Recycled and Purified Water
Local Dams and Reservoirs
Water Quality
Water Supply Planning
Current Water Charges
Find Your Water Retailer
ALERT System Real Time Data
One Water Plan

A6. Environmental Documentation

ENVIRONMENTAL INFORMATION FORM
Alternative GSP Submittals

Submitting Agency: Santa Clara Valley Water District (Valley Water)

Contact Person: Vanessa De La Piedra

Phone Number: (408) 630-2788 Email Address: vdelapiedra@valleywater.org

Address: 5750 Almaden Expressway, San Jose CA 95118

1. Has the Submitting Agency determined that the Alternative is exempt from CEQA?
   ☑ Yes ☐ No

   If yes, check appropriate box below, and then proceed to #4 :

☐ Submitting Agency has filed a Notice of Exemption (NOE) with the State Clearinghouse and/or County Clerk. Attach a copy of NOE and, if applicable, a copy of Board Resolution.

☑ Submitting Agency will file a NOE with the State Clearinghouse and/or County Clerk. Provide estimated date: 10/15/21

☐ Submitting Agency will NOT file a NOE with the State Clearinghouse and/or County Clerk.

2. If the Alternative will require CEQA compliance, identify the Lead Agency, if different from the Submitting Agency.

   CEQA Lead Agency: _____

3. Please check types of CEQA documents that have been prepared:

   ☐ Initial Study
   ☐ Negative Declaration
   ☐ Mitigated Negative Declaration
   ☐ Environmental Impact Report

4. This form was completed by:

Kelly White	(415) 308-9909
Print or Type Name	Phone Number
Kelly ce White	October 12, 2021
Signature	Date

☐ DWR received environmental documents.

☐ DWR made findings.

Please send the completed form to DWR's SGM Program.

DocuSign Envelope ID: 6AE70C59-9B5C-4543-ACBD-DDD3C2B9A770

Valley Water

MEMORANDUM

TO: Scott Akin
Environmental Services Unit Manager

FROM: Kelly White
Associate Environmental Planner

SUBJECT: 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

DATE: October 12, 2021

RECOMMENDATION

This memorandum provides the basis for the recommendation that the Santa Clara Valley Water District (Valley Water) 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins (project or proposed project) is statutorily exempt from California Environmental Quality Act (CEQA) environmental review.[1]

Issue

Whether the 2021 Groundwater Management Plan meets the standard for the statutory exemption as defined under CEQA §15262.

CEQA STANDARD

The statutory exemption is provided in CEQA §15262, which states:

> *"A project involving only feasibility and planning studies for possible future actions which the agency, board, or commission has not approved, adopted, or funded does not require the preparation of an EIR or Negative Declaration but does require consideration of environmental factors. This section does not apply to the adoption of a plan that will have a legally binding effect on later activities."*

ANALYSIS

The District Act (California Water Code Appendix, Chapter 60) provides Valley Water with broad groundwater management authority, including the authority to protect, spread, store, retain, and cause water to percolate in the soil within Santa Clara County. On September 16, 2014, the Sustainable Groundwater Management Act (SGMA) was signed into law and adopted into the California Water Code, commencing with §10720. The legislative intent of SGMA is to provide for the sustainable management of groundwater basins, to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater.

On May 24, 2016, the Valley Water Board of Directors adopted Resolution 16-51 on the Decision to Become the Groundwater Sustainability Agency for the Santa Clara and Llagas Subbasins. The Santa

[1] CA Code of Regulations Title 14 §15262.

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Clara and Llagas Subbasins are deemed to be high-priority basins by the California Department of Water Resources (DWR) and therefore require the development of a Groundwater Sustainability Plan or a prescribed alternative. California Water Code §10733.6(b)(1) identifies an acceptable Alternative Plan as a plan developed pursuant to other law, such as the District Act, authorizing groundwater management. Valley Water is committed to its legislatively created mandate to manage the surface water and groundwater resources within its jurisdiction. The 2021 Groundwater Management Plan (GWMP) describes Valley Water's comprehensive framework to ensure continued, sustainable groundwater conditions in the Santa Clara and Llagas Subbasins.

Valley Water's GWMP is a planning study that sets for goals and objectives as well as possible future actions for management of the Santa Clara and Llagas Subbasins. No specific actions will be approved, adopted, or funded by the Board by adopting the GWMP. Any future actions taken by Valley Water to meet the goals and objectives of the GWMP will be considered at that time and environmental review of those actions will be considered per CEQA. Thus, Valley Water's GWMP is statutorily exempt per CEQA §15262.

CONCLUSION

Adoption of Valley Water's GWMP does not approve, adopt, or fund any specific future actions. Therefore, the GWMP meets the definition of a planning study under CEQA §15262.

DocuSigned by:
Kelly White
ADB88CBA901846A...

10/13/2021

Kelly White
Associate Environmental Planner
O&M Environmental Services Unit

Date

Concur:

DocuSigned by:
Scott Akin
58E0FF93544843C...

10/13/2021

Scott Akin
Environmental Services Manager
O&M Environmental Services Unit

Date

cc: CEQA Administrative Record

DocuSign Envelope ID: 6AE70C59-9B5C-4543-ACBD-DDD3C2B9A770

Public Notice

Notice of Exemption

Valley Water

To: Santa Clara County
Clerks Office, Business Division
70 West Hedding Street
San Jose CA 95110

From: Santa Clara Valley Water District
5750 Almaden Expressway
San Jose CA 95118-3686
Telephone (408) 265-2600

Project Title: 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Project Location-City:
San Jose, Palo Alto, Mountain View, Sunnyvale, Saratoga, Santa Clara, Milpitas, Monte Sereno, Los Altos, Los Altos Hills, Cupertino, Campbell, Los Gatos, Gilroy, and Morgan Hill

Project Location-County: Santa Clara

Project Purpose: This is the first required 5-year update to the 2016 Groundwater Management Plan for the Santa Clara and Llagas Subbasins

Name of Public Agency Approving Project: Santa Clara Valley Water District

Name of Agency or Person Carrying Out Project: Santa Clara Valley Water District

Exempt Status: (*check one*)

- ☐ Ministerial [Sec. 21080(b)(1); 15268];
- ☐ Declared Emergency [Sec. 21080(b)(3); 15269(a)];
- ☐ Emergency Project [Sec. 21080(b)(c)];
- ☐ Categorical Exemptions
- ☒ Statutory Exemptions [*15262*].

Reasons Why Project is Exempt: The project qualifies for the following exemptions:

Feasibility and Planning Studies (CEQA Guidelines §15262)

> *A project involving only feasibility and planning studies for possible future actions which the agency, board, or commission has not approved, adopted, or funded does not require the preparation of an EIR or Negative Declaration but does require consideration of environmental factors. This section does not apply to the adoption of a plan that will have a legally binding effect on later activities*

No specific actions will be approved, adopted, or funded by the Valley Water Board of Directors by adopting the 2021 GWMP.

Description of Project:
The 2021 GWMP updates the Valley Water's Board adopted 2016 GWMP, which was submitted in 2016 to the California Department of Water Resources (DWR) as an Alternative to a Groundwater Sustainability Plan under the Sustainable Groundwater Management Act (SGMA). In July 2019, DWR approved the Alternative for both the Santa Clara and Llagas subbasins, determining that it satisfies the objectives of SGMA. Five-year updates are required under SGMA, with Valley Water's next update due to DWR by January 1, 2022.

The 2021 GWMP includes the following information:

DocuSign Envelope ID: 6AE70C59-9B5C-4543-ACBD-DDD3C2B9A770

1) A description of hydrogeological conditions and Valley Water's authorities to manage groundwater;

2) Basin sustainability goals and strategies;

3) Programs and activities that support the sustainability goals;

4) Monitoring and performance outcome measurement; and

5) Recommendations and next steps for groundwater management.

No specific actions will be approved, adopted, or funded by the Valley Water Board of Directors by adopting the 2021 GWMP.

Lead Agency: Santa Clara Valley Water District
Contact Person: Kelly White

Area Code/Telephone/Extension
(415) 308-9909

Signature: DocuSigned by: Vanessa De La Piedra 419EAC040981415... Date: 10/13/2021

Title: Vanessa De La Piedra
Acting Deputy Operating Officer
Raw Water Division

cc: CEQA Administrative Record

Santa Clara County - Clerk-Recorder Office
State of California

County of Santa Clara

Office of the County Clerk-Recorder
Business Division

County Government Center
70 West Hedding Street, E. Wing, 1st Floor
San Jose, California 95110 (408) 299-5688

File Number: ENV23606
ENVIRONMENTAL FILING
No. of Pages: 3
Total Fees: $50.00
File Date: 10/21/2021
Expires: 11/20/2021

REGINA ALCOMENDRAS, Clerk-Recorder
By: Elaine Fader, Deputy Clerk-Recorder

CEQA DOCUMENT DECLARATION

ENVIRONMENTAL FILING FEE RECEIPT

PLEASE COMPLETE THE FOLLOWING:

1. **LEAD AGENCY:** Santa Clara Valley Water District (Valley Water)
2. **PROJECT TITLE:** 2021 Groundwater Management Plan for the Santa Clara and Llagas Subbasins
3. **APPLICANT NAME:** Santa Clara Valley Water District (Valley Water) **PHONE:** (408) 265-2600
4. **APPLICANT ADDRESS:** 5750 Almaden Expressway, San Jose, CA 95118-3686
5. **PROJECT APPLICANT IS A:** ☐ Local Public Agency ☐ School District ☒ Other Special District ☐ State Agency ☐ Private Entity
6. **NOTICE TO BE POSTED FOR** 30 **DAYS.**
7. **CLASSIFICATION OF ENVIRONMENTAL DOCUMENT** Notice of Exemption

a. **PROJECTS THAT ARE SUBJECT TO DFG FEES**

☐ 1. ENVIRONMENTAL IMPACT REPORT (PUBLIC RESOURCES CODE §21152)	$ 3,445.25	$ 0.00
☐ 2. NEGATIVE DECLARATION (PUBLIC RESOURCES CODE §21080(C)	$ 2,480.25	$ 0.00
☐ 3. APPLICATION FEE WATER DIVERSION (STATE WATER RESOURCES CONTROL BOARD ONLY)	$ 850.00	$ 0.00
☐ 4. PROJECTS SUBJECT TO CERTIFIED REGULATORY PROGRAMS	$ 1,171.25	$ 0.00
☐ 5. COUNTY ADMINISTRATIVE FEE (REQUIRED FOR a-1 THROUGH a-4 ABOVE) Fish & Game Code §711.4(e)	$ 50.00	$ 0.00

b. **PROJECTS THAT ARE EXEMPT FROM DFG FEES**

☒ 1. NOTICE OF EXEMPTION ($50.00 COUNTY ADMINISTRATIVE FEE REQUIRED)	$ 50.00	$ 50.00
☐ 2. A COMPLETED "CEQA FILING FEE NO EFFECT DETERMINATION FORM" FROM THE DEPARTMENT OF FISH & GAME, DOCUMENTING THE DFG'S DETERMINATION THAT THE PROJECT WILL HAVE NO EFFECT ON FISH, WILDLIFE AND HABITAT, OR AN OFFICIAL, DATED RECEIPT / PROOF OF PAYMENT SHOWING PREVIOUS PAYMENT OF THE DFG FILING FEE FOR THE *SAME PROJECT IS ATTACHED ($50.00 COUNTY ADMINISTRATIVE FEE REQUIRED)		
DOCUMENT TYPE: ☐ ENVIRONMENTAL IMPACT REPORT ☐ NEGATIVE DECLARATION	$ -50.00	$ 0.00

c. **NOTICES THAT ARE *NOT* SUBJECT TO DFG FEES *OR* COUNTY ADMINISTRATIVE FEES**

☐ NOTICE OF PREPARATION ☐ NOTICE OF INTENT	NO FEE	$ NO FEE

8. **OTHER:** _____ **FEE (IF APPLICABLE):** $ _____
9. **TOTAL RECEIVED** ..... $ 50.00

*NOTE: "*SAME PROJECT*" MEANS NO CHANGES. IF THE DOCUMENT SUBMITTED IS NOT THE SAME (OTHER THAN DATES), A "NO EFFECT DETERMINATION" LETTER FROM THE DEPARTMENT OF FISH AND GAME FOR THE SUBSEQUENT FILING OR THE APPROPRIATE FEES ARE REQUIRED.

THIS FORM MUST BE COMPLETED AND ATTACHED TO THE FRONT OF ALL CEQA DOCUMENTS LISTED ABOVE (*INCLUDING COPIES*) SUBMITTED FOR FILING. WE WILL NEED AN ORIGINAL (WET SIGNATURE) AND TWO (2) COPIES. IF THERE ARE ATTACHMENTS, PLEASE PROVIDE THREE (3) SETS OF ATTACHMENTS FOR SUBMISSION. *(YOUR ORIGINAL WILL BE RETURNED TO YOU AT THE TIME OF FILING.)*

CHECKS FOR ALL FEES SHOULD BE MADE PAYABLE TO: SANTA CLARA COUNTY CLERK-RECORDER

PLEASE NOTE: FEES ARE ANNUALLY ADJUSTED (Fish & Game Code §711.4(b); PLEASE CHECK WITH THIS OFFICE AND THE DEPARTMENT OF FISH AND GAME FOR THE LATEST FEE INFORMATION.

"*. . . NO PROJECT SHALL BE OPERATIVE, VESTED, OR FINAL, NOR SHALL LOCAL GOVERNMENT PERMITS FOR THE PROJECT BE VALID, UNTIL THE FILING FEES REQUIRED PURSUANT TO THIS SECTION ARE PAID.*" Fish & Game Code §711.4(c)(3)

(Fees Effective 01-01-2021)

DocuSign Envelope ID: 6AE70C59-9B5C-4543-ACBD-DDD3C2B9A770

Public Notice

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Name of Agency or Person Carrying Out Project: Santa Clara Valley Water District

Exempt Status: (*check one*)

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- ☐ Declared Emergency [Sec. 21080(b)(3); 15269(a)];
- ☐ Emergency Project [Sec. 21080(b)(c)];
- ☐ Categorical Exemptions
- ☒ Statutory Exemptions [*15262*].

Reasons Why Project is Exempt: The project qualifies for the following exemptions:

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The 2021 GWMP includes the following information:

1) A description of hydrogeological conditions and Valley Water's authorities to manage groundwater;

2) Basin sustainability goals and strategies;

3) Programs and activities that support the sustainability goals;

4) Monitoring and performance outcome measurement; and

5) Recommendations and next steps for groundwater management.

No specific actions will be approved, adopted, or funded by the Valley Water Board of Directors by adopting the 2021 GWMP.

Lead Agency: Santa Clara Valley Water District
Contact Person: Kelly White

Area Code/Telephone/Extension
(415) 308-9909

Signature: DocuSigned by: Vanessa De La Piedra 419EAC040851415...

Date: 10/13/2021

Title: Vanessa De La Piedra
Acting Deputy Operating Officer
Raw Water Division

cc: CEQA Administrative Record

Appendix B – Demonstration of Functional Equivalency

Valley Water has prepared the 2021 Groundwater Management Plan (GWMP) under authority granted by the District Act. The 2021 GWMP demonstrates how Valley Water will continue to sustainably manage the Santa Clara and Llagas subbasins. The comprehensive framework documented in this plan includes authorities, sustainability goals and strategies, conjunctive management and monitoring programs, long-term planning, numeric outcome measures, and corresponding outcome measure-lower thresholds that effectively prompt action when needed.

In 2019, DWR approved the GWMP submitted in 2016 as an Alternative Plan because it satisfies the objectives of SGMA. This 2021 GWMP is the first five-year update to the approved Alternative Plan. The 2021 GWMP continues to meet the requirements of an Alternative to a GSP in accordance with Water Code Section 10733.6 (b)(1) and Article 9 of the Emergency GSP Regulations.[1] Alternatives must be functionally equivalent to requirements in Articles 5 and 7 of the Emergency GSP Regulations. This plan meets the intent of SGMA and is functionally equivalent to Articles 5 and 7 of the Emergency GSP Regulations, as described in this Appendix.

General Requirements of Article 5

The functional equivalence of this GWMP to the five subarticles of Article 5 is summarized below.

1) Administrative Information

   The GWMP provides detailed information on the plan area as well as Valley Water's legal authorities, governance, management structure, and funding sources. As a special act district created in 1929 to manage groundwater, Valley Water has a well-established framework to fund and implement successful conjunctive management programs through the Water Utility Enterprise, which has a $580 million operations and capital budget for fiscal year 2021-2022.

   The GWMP also describes how Valley Water accounts for future land use and water demand changes through the Urban Water Management Plan and Water Supply Master Plan, which have a 25-year planning horizon and are updated every five years. Beneficial uses, users, and outreach are also described in various sections of the GWMP.

2) Basin Setting

   The GWMP contains detailed information on the Santa Clara and Llagas subbasins with regard to basin structure, boundaries, stratigraphy, and recharge areas. Basin conditions related to water levels, water quality, land subsidence, seawater intrusion, interconnected surface waters, and groundwater dependent ecosystems (GDEs) are also described in detail. The GWMP also presents balanced water budgets and future groundwater demands and budgets considering climate change and expected population growth.

3) Sustainable Management Criteria

   Valley Water's 2016 GWMP documented numeric outcome measures to assess performance in meeting basin sustainability goals. These outcome measures relate to groundwater storage, land subsidence, and water quality and are largely unchanged in the 2021 GWMP because they have been effective in avoiding undesirable results and prompting action when needed. The 2021 GWMP has a new outcome measure for seawater intrusion. As described in Chapter 5, a substantial update in the 2021 GWMP are new outcome measure-lower thresholds that are functionally equivalent to minimum thresholds and help define conditions that constitute undesirable results. For example, Valley Water's outcome measure and corresponding outcome measure-lower threshold for groundwater storage are related to Valley Water's Water Shortage Contingency Plan. The

[1] California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2.

recent 2012–2016 drought resulted in lower storage, prompting the Board to request short-term water use reduction. An impressive response by the community, coupled with water retailers' efforts to use more treated surface water in lieu of groundwater, resulted in a rapid recovery in groundwater storage during 2016 to the normal stage of the Water Shortage Contingency Plan. During the current (2021) drought, the Board has again mandated short-term water use reductions. Valley Water is actively working with the community and water retailers to help maintain the water storage above the outcome measure. All outcome measures and outcome measure-lower thresholds will be evaluated annually and related reporting occurs through Valley Water's Annual Groundwater Report and annually in the Water Year Reports due each April 1 to DWR.

4) Monitoring Networks

Valley Water has established extensive networks to monitor groundwater levels, groundwater quality, land subsidence, and surface water. Valley Water evaluates data from hundreds of wells measured directly and also leverages groundwater level and quality data collected by water retailers. Detailed information on monitoring results is available through Valley Water's Annual Groundwater Report and Water Year Reports. Valley Water also prepares a monthly Water Tracker, which summarizes water supply conditions, and the companion monthly Groundwater Condition Report. These reports are available on Valley Water's website, as is groundwater level data and real-time stream, reservoir, and precipitation data.

5) Projects and Management Actions

For more than 80 years, Valley Water has implemented conjunctive water management programs to maximize water supply reliability. These programs include the direct managed recharge of about 100,000 AF of local and imported surface water each year. Valley Water's in-lieu recharge programs, including treated surface water deliveries, water conservation, and water recycling, account for over 200,000 AF in most years. These programs require extensive infrastructure and rely on substantial local water rights and imported water agreements. Valley Water also implements programs to ensure groundwater quality is protected, such as the well ordinance program. The GWMP contains detailed information on programs implemented by Valley Water and other agencies to protect local groundwater.

General Requirements of Article 7

The functional equivalence of this GWMP to the Article 7 requirements is described below.

1) Annual Water Year Reports

Agencies are required to submit an annual water year report to DWR with information on groundwater elevations, pumping, recharge, total water use, and change in storage for the preceding water year. Each year, Valley Water prepares a comprehensive Annual Groundwater Report with detailed information on groundwater conditions for the preceding calendar year, including all the information listed above. This report is posted to Valley Water's website. Additionally, Valley Water has submitted annual Water Year Report to DWR in 2017, 2018, 2019, and 2020, and will continue submitting these annual reports during the next five-year update cycle.

2) Periodic Evaluations by the Agency

Article 7 also requires agencies to review their plans at least every five years and provide a written assessment to DWR. Article 9 (Alternatives) requires Alternatives to be submitted by January 1, 2017 and every five years thereafter. Both these requirements are aligned with Valley Water's goal of updating the GWMP every five years. This approach supports updates to Valley Water's Urban Water Management Plan

and Water Supply Master Plan, which are also on five-year update cycles. This 2021 GWMP is the first five-year update to the approved Alternative Plan.

DWR's Alternative Element Guide[2] (Table 1) is provided to further demonstrate functional equivalency and facilitate review of this GWMP as an approved Alternative.

Table 1. Alternative Element Guide

California Code of Regulations - GSP Regulation Sections	Alternative Elements	Document which attachment(s) contains the applicable alternative element.	Document which section(s), page number(s), or briefly describe why that Alternative element does not apply to the entity.
Article 5 - Plan Contents			
SubArticle 1	**Administrative Information**		
§ 354.4.	**General Information**		**2021 Groundwater Management Plan (GWMP) Section**
	(a) An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.	2021 GWMP	Executive Summary
	(b) A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.		References
§ 354.6.	**Agency Information**		
	When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:	2021 GWMP	

[2] DWR's Alternative Element Guide is available on the SGMA portal https://sgma.water.ca.gov/portal/resources

	(a) The name and mailing address of the Agency.		§ 1.1
	(b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.		§§ 1.1–1.4
	(c) The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.		§ 1.1
	(d) The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.		§§ 1.3, 1.4.2
	(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.		§§ 1.3, 1.4.2.2, 6.1.4.3
§ 354.8.	**Description of Plan Area**		
	Each Plan shall include a description of the geographic areas covered, including the following information:	2021 GWMP	§§ 2.1, 3.1, 4.2, 4.4.1.1, 4.4.2.1
	(a) One or more maps of the basin that depict the following, as applicable:		
	(1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.		Figures ES-2, 1-1, 2-1, 3-1
	(2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.		Not applicable
	(3) Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.		Figures ES-2, 1-1
	(4) Existing land use designations and the identification of water use sector and water source type.		Figures 4-1; Appendix G

	(5) The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.		Figures 4-8, 4-12
	(b) A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.		§§ 2.1, 3.1
	(c) Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.		Chapters 6, 7
	(d) A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.		Chapter 6
	(e) A description of conjunctive use programs in the basin.		§§ 4.3, 6.1, 6.3, 6.4
	(f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:		§§ 1.3, 1.4, 4.5, 4.6, 5.3, 6.1, 6.2
	(1) A summary of general plans and other land use plans governing the basin.		§§ 1.3, 1.4.5
	(2) A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects.		§§ 1.4.5, 4.5, 4.6, 5.3, 6.1, 6.2

	(3) A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.		§§ 1.4.5, 4.5, 4.6
	(4) A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.		§ 6.2
	(5) To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.		§ 1.4.5
	(g) A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.		Not applicable
§ 354.10.	**Notice and Communication**		
	Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:	2021 GWMP	Appendix A
	(a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.		Executive Summary, Chapter 1, Appendix A
	(b) A list of public meetings at which the Plan was discussed or considered by the Agency.		Appendix A
	(c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.		Appendix A
	(d) A communication section of the Plan that includes the following:		
	(1) An explanation of the Agency's decision-making process.		§§ 1.4, 1.5, Appendix A, Appendix F
	(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.		§§ 1.6, Appendix A

	(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.		§§ 1.5, 1.6, Appendix A
	(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.		§§ 1.5
SubArticle 2	**Basin Setting**		
§ 354.14.	**Hydrogeologic Conceptual Model**		
	(a) Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.	2021 GWMP	Chapters 2, 3
	(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:		Chapters 2, 3
	(1) The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.		Chapters 2, 3
	(2) Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.		Chapters 2, 3
	(3) The definable bottom of the basin.		Chapters 2, 3
	(4) Principal aquifers and aquitards, including the following information:		Chapters 2, 3
	(A) Formation names, if defined.		Chapters 2, 3
	(B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.		Chapters 2, 3
	(C) Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.		Chapters 2, 3
	(D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.		Chapters 2, 3

	(E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.		Chapters 2, 3
	(5) Identification of data gaps and uncertainty within the hydrogeologic conceptual model		Chapters 2, 3
	(c) The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.		Figures 2-4, 2-5, 2-22, 2-24, 2-25, 3-4, 3-5, 3-6
	(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:		Figures 1-2, 1-4, 2-1, 2-2, 2-4, 2-5, 2-6, 2-14, 3-1, 3-2, 3-4, 3-5, 3-6
	(1) Topographic information derived from the U.S. Geological Survey or another reliable source.		Figure 1-2
	(2) Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.		Figures 2-2, 3-2
	(3) Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.		Figures 2-2, 3-2
	(4) Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.		Figures 2-1, 2-14, 3-1,
	(5) Surface water bodies that are significant to the management of the basin.		Figure 1-4
§ 354.16.	**Groundwater Conditions**		
	Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:	2021 GWMP	§§ 2.2, 3.2
	(a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:		§§ 2.2, 3.2

	(1) Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.		Figures 2-8, 2-9, 3-9, 3-10
	(2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.		Figures 2-10, 2-11, 3-8
	(b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.		§§ 4.4; Figures 4-9, 4-10, 4-13
	(c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.		§ 2.2, 2.2.6; Appendix H; Figures 2-22, 2-23, 2-24, 2-25
	(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.		§§ 2.2, 3.2, 6.2; Figures 6-1, 6-2
	(e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		§ 2.2 Figures 2-12, 2-13
	(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		§§ 2.2, 3.2
	(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		§§ 2.2, 3.2; Appendix G; Figures 2-17, 3-13; Tables 2-1, 3-1
§ 354.18.	**Water Budget**		

	(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.	2021 GWMP	§§ 4.4, 4.5; Figure 4-5; Tables 4-3, 4-4, 4-6, 4-10
	(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:		§ 4.4
	(1) Total surface water entering and leaving a basin by water source type.		§ 4.4
	(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.		§ 4.4
	(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.		§ 4.4
	(4) The change in the annual volume of groundwater in storage between seasonal high conditions.		§ 4.4
	(5) If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.		Not applicable
	(6) The water year type associated with the annual supply, demand, and change in groundwater stored.		§ 4.4
	(7) An estimate of sustainable yield for the basin.		Not applicable (§ 4.4)
	(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:		§§ 4.4, 4.5
	(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.		§ 4.4

	(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:		§ 4.4
	(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.		§ 4.4
	(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.		§ 4.4
	(C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.		§ 4.4
	(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:		§ 4.5

	(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.		§ 4.5
	(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.		§ 4.5
	(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.		§ 4.5
	(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:		§§ 4.4, 4.5, 6.1
	(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.		§§ 4.4, 4.5
	(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.		§§ 4.4, 4.5
	(3) Projected water budget information for population, population growth, climate change, and sea level rise.		§ 4.5

	(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.		§§ 4.4, 4.5, 7.6
	(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.		§ 7.6
§ 354.20.	**Management Areas**		
	(a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.	2021 GWMP	Executive Summary, § 2.1
	(b) A basin that includes one or more management areas shall describe the following in the Plan:		
	(1) The reason for the creation of each management area.		Executive Summary, § 2.1
	(2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.		§ 5.4

	(3) The level of monitoring and analysis appropriate for each management area.		Chapters 2, 7
	(4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.		§ 5.4
	(c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.		Chapter 2
SubArticle 3	**Administrative Information**		
§ 354.24.	**Sustainability Goal**		
	Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.	2021 GWMP	Chapters 5, 6, 8
§ 354.26.	**Undesirable Results**		
	(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.	2021 GWMP	Chapters 2, 3, 5; § 5.4
	(b) The description of undesirable results shall include the following:		
	(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.		Chapters 2, 3, 5; § 5.4

	(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.		§ 5.4
	(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.		Chapters 2, 3, 5; § 5.4
	(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.		§ 5.4
	(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.		Chapters 2, 3, 5; § 5.4
§ 354.28.	**Minimum Threshold**		
	(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.	2021 GWMP	§§ 2.2, 3.2, 5.4, Chapter 5
	(b) The description of minimum thresholds shall include the following:		

	(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.		§§ 2.2, 3.2, 5.4
	(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.		§§ 2.2, 3.2, 5.4
	(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.		§§ 2.2, 3.2, 5.4
	(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.		§§ 2.2, 3.2, 5.4
	(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.		§ 5.4
	(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.		§ 5.4, Chapter 7
	(c) Minimum thresholds for each sustainability indicator shall be defined as follows:		
	(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:		§§ 2.2, 3.2, 5.4

	(A) The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.		§§ 2.2, 3.2, 5.4
	(B) Potential effects on other sustainability indicators.		§§ 2.2, 3.2, 5.4
	(2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.		§§ 2.2, 3.2, 5.4
	(3) Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:		§§ 2.2, 5.4, Appendix H
	(A) Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.		§§ 2.2, 5.4, Appendix H; Figures 2-22, 2-23
	(B) A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.		§§ 2.2, 5.4, Appendix H; Figures 2-22, 2-23, 2-24, 2-25
	(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.		§§ 2.2, 3.2, 5.4

	(5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:		§§ 2.2, 5.4
	(A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.		§§ 2.2, 5.4; Figures 2-12, 2-13
	(B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.		Figures 2-12, 2-13
	(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:		Not Applicable (§§ 2.2.3, 5.4)
	(A) The location, quantity, and timing of depletions of interconnected surface water.		Not Applicable (§§ 2.2.3, 5.4)
	(B) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.		Not Applicable (§§ 2.2.3, 5.4)
	(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.		Not Applicable (§ 5.4)

	(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.		Chapter 2, 3, §5.4
§ 354.30.	**Measurable Objectives**		
	(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.	2021 GWMP	Executive Summary, Chapter 5, 8
	(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.		§5.4
	(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.		§5.4
	(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.		Not Applicable (§ 5.4)
	(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.		Executive Summary, Chapter 5, 8

	(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.		Not Applicable
	(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.		Not Applicable
SubArticle 4	**Monitoring Networks**		
§ 354.34.	**Monitoring Network**		
	(a) Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.	2021 GWMP	Chapter 7
	(b) Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:		§§ 7.1, 7.2, 7.3, 7.4, 7.5
	(1) Demonstrate progress toward achieving measurable objectives described in the Plan.		§§ 7.1, 7.2, 7.3, 7.4, 7.5
	(2) Monitor impacts to the beneficial uses or users of groundwater.		§§ 7.1, 7.2, 7.3, 7.4, 7.5
	(3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.		§§ 7.1, 7.2, 7.3, 7.4, 7.5
	(4) Quantify annual changes in water budget components.		§§ 7.1, 7.2, 7.3, 7.4, 7.5

	(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:		
	(1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:		§ 7.1
	(A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.		§ 7.1
	(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.		§ 7.1
	(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.		§ 7.1
	(3) Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.		§ 7.3; Appendix H
	(4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.		§ 7.3
	(5) Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.		§ 7.2

	(6) Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:		§ 7.4
	(A) Flow conditions including surface water discharge, surface water head, and baseflow contribution.		§ 7.4
	(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.		§ 7.4
	(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.		§ 7.4
	(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.		§ 7.4
	(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.		Chapter 7; Appendix J
	(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.		Chapter 7; Appendix J
	(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:		Chapter 7; Appendix K
	(1) Amount of current and projected groundwater use.		Chapter 7
	(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.		Chapter 7

	(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.		Chapter 7
	(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.		Chapter 7
	(g) Each Plan shall describe the following information about the monitoring network:		
	(1) Scientific rationale for the monitoring site selection process.		Chapter 7
	(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.		Chapter 7
	(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.		Chapter 7
	(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.		Chapter 7; Appendix K
	(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.		Chapter 7

	(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.		Chapters 2, 3, 5, 7
§ 354.36.	**Representative Monitoring**		
	Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:	2021 GWMP	Chapters 5, 7
	(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.		Chapters 5, 7
	(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:		Chapters 5, 7
	(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.		Chapters 5, 7
	(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.		Chapters 5, 7
	(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.		Chapters 5, 7
§ 354.38.	**Assessment and Improvement of Monitoring Network**		
	(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.	2021 GWMP	Chapter 7; Appendix J

J	(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.		Chapter 7; Appendix J
	(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:		Chapter 7; Appendix J
	(1) The location and reason for data gaps in the monitoring network.		Chapter 7; Appendix J
	(2) Local issues and circumstances that limit or prevent monitoring.		Chapter 7; Appendix J
	(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.		Chapters 7, 8; Appendix J
	(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:		Chapters 7, 8; Appendix J
	(1) Minimum threshold exceedances.		Chapters 7, 8; Appendix J
	(2) Highly variable spatial or temporal conditions.		Chapters 7, 8; Appendix J
	(3) Adverse impacts to beneficial uses and users of groundwater.		Chapters 7, 8; Appendix J
	(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.		Chapters 7, 8; Appendix J
§ 354.40.	**Reporting Monitoring Data to the Department**		
	Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.	2021 GWMP	Chapter 7
SubArticle 5	**Projects and Management Actions**		

§ 354.44	Projects and Management Actions		
	a) Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.	2021 GWMP	Chapters 6, 8
	(b) Each Plan shall include a description of the projects and management actions that include the following:		
	(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:		Chapters 6, 8
	(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.		Chapters 6, 8
	(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.		Chapters 6, 8
	(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.		Chapters 6, 8
	(3) A summary of the permitting and regulatory process required for each project and management action.		Chapter 6
	(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.		Chapter 6

	(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.		Chapter 6
	(6) An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.		Chapter 6
	(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.		Chapter 6
	(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.		Chapter 6
	(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.		Chapters 1, 4, 6
	(c) Projects and management actions shall be supported by best available information and best available science.		Chapters 1, 4, 6
	(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.		Chapters 1, 4, 6
Article 7	**Annual Reports and Periodic Evaluations by the Agency**		**Water Year Reports 2017, 2018, 2019, 2020**
§ 356.2	**Annual Reports**		
	Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:	Water Year Reports	
	(a) General information, including an executive summary and a location map depicting the basin covered by the report.		Executive Summary
	(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:		

	(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:		Chapter 2
	(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.		Chapter 2
	(B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.		Chapter 2
	(2) Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.		Chapter 3
	(3) Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.		Chapter 3
	(4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.		Chapter 3
	(5) Change in groundwater in storage shall include the following:		Chapter 3
	(A) Change in groundwater in storage maps for each principal aquifer in the basin.		Chapter 3

	(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.		Chapter 3
	(c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.		Chapter 4
§ 356.4	**Periodic Evaluation by Agency**		**2021 GWMP**
	Each Agency shall evaluate its Plan at least every five years and whenever the Plan is amended, and provide a written assessment to the Department. The assessment shall describe whether the Plan implementation, including implementation of projects and management actions, are meeting the sustainability goal in the basin, and shall include the following:		
	(a) A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones and minimum thresholds.		Chapters 2, 3, 4, 5
	(b) A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.		Chapters 6, 8
	(c) Elements of the Plan, including the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives, shall be reconsidered and revisions proposed, if necessary.		Appendix C
	(d) An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the Agency's evaluation shows that the basin is experiencing overdraft conditions, the Agency shall include an assessment of measures to mitigate that overdraft.	2021 GWMP	Chapters 2, 3, 4

	(e) A description of the monitoring network within the basin, including whether data gaps exist, or any areas within the basin are represented by data that does not satisfy the requirements of Sections 352.4 and 354.34(c). The description shall include the following:		Chapter 7; Appendix J
	(1) An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of Section 354.38.		Chapter 7; Appendix J
	(2) If the Agency identifies data gaps, the Plan shall describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Plan.		Chapters 7, 8; Appendix J
	(3) The Plan shall prioritize the installation of new data collection facilities and analysis of new data based on the needs of the basin.		Chapters 7, 8; Appendix J
	(f) A description of significant new information that has been made available since Plan adoption or amendment, or the last five-year assessment. The description shall also include whether new information warrants changes to any aspect of the Plan, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.		Appendix C
	(g) A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the Plan.		Chapter 6
	(h) Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the basin.		Not Applicable
	(i) A description of completed or proposed Plan amendments.		Appendix C
	(j) Where appropriate, a summary of coordination that occurred between multiple Agencies in a single basin, Agencies in hydrologically connected basins, and land use agencies.		Not Applicable

	(k) Other information the Agency deems appropriate, along with any information required by the Department to conduct a periodic review as required by Water Code Section 10733.		Not Applicable

Appendix C – Response to DWR Recommended Actions

On December 21, 2016, Valley Water submitted the 2016 Groundwater Management Plan (GWMP) as an Alternative to the Groundwater Sustainability Plan (GSP) prior to the statutory deadline of January 1, 2017. Water Code Section 10733.6(b) allows for several different types of Alternatives, including an existing groundwater management plan. On July 17, 2019, DWR approved the Alternative for both the Santa Clara and Llagas Subbasins[1,2] because it satisfies the objectives of SGMA.

Department of Water Resources (DWR) Recommended Actions

In DWR's cover letters for approval of the Alternative (Appendix C-1 and C-2), they noted in the Alternative Assessment Staff Report "…proposed recommended actions for the consideration of the Santa Clara Valley Water District that the Department believes will enhance the Alternative and facilitate future evaluation by the Department. The recommended actions do not constitute a qualified approval of the Alternative; however, the Department encourages they be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates."

In the Alternative Assessment Staff Reports (Appendix C-1 and C-2), DWR made five recommended actions for the Santa Clara Subbasin[1] and four recommended actions for the Llagas Subbasin[2]. Four of the five recommended actions are essentially the same for the Santa Clara and Llagas Subbasins (see 1 – 4 below). The fifth recommended action is relevant only for the Santa Clara Subbasin (see 5 below). The DWR Recommended Actions are as follows:

1. Staff recommend that the District provide an identification of groundwater dependent ecosystems in the Subbasin.

2. Staff recommend that the District provide a projected water budget incorporating climate change and expected population growth over the planning and implementation horizon of 50 years. (Note – the recommended action for the Llagas Subbasin did NOT include the phrase "…and expected population growth…" but is otherwise the same).

3. Staff recommend that the District create separate outcome measures related to water quality in the Santa Clara and Llagas subbasins. Separate subbasin-specific criteria will allow for a determination of whether each subbasin, separately, is meeting or making progress toward the outcome measures.

4. Staff recommend that the District clarify how meeting its outcome measures relates to the avoidance of undesirable results in the Santa Clara [Llagas] Subbasin. Specifically, it should clarify whether not meeting the outcome measures represents an undesirable result for the applicable sustainability indicator. If that is not the intent of the District, then it should provide additional clarification and additional metrics that can be used by the District, and by the Department as it reviews the Alternative on an ongoing basis, to determine what effects represent undesirable results and to objectively assess the presence or absence of those undesirable results.

[1] Department of Water Resources, Sustainable Groundwater Management Office, Alternative Assessment Staff Report for the Santa Clara Subbasin, dated July 17, 2019.
[2] Department of Water Resources, Sustainable Groundwater Management Office, Alternative Assessment Staff Report for the Llagas Subbasin, dated July 17, 2019.

5. Staff recommend the District develop specific seawater intrusion outcome measures separate from other water quality outcome measures. (for the Santa Clara Subbasin only)

2021 GWMP Addresses DWR Recommended Actions

The 2021 GWMP is the first five-year update to the 2016 GWMP. Valley Water staff have responded to all five of DWR recommended actions. The following sections explain how the 2021 GWMP addresses each recommended action.

Recommended Action 1

Within the Basin Setting of the 2021 GWMP, section 2.2.4 Groundwater Dependent Ecosystems includes a new map identifying groundwater dependent ecosystems (GDEs) for the Santa Clara Subbasin, and section 3.2.4 Groundwater Dependent Ecosystems includes a new map identifying GDEs for the Llagas Subbasin. A detailed technical memorandum that documents the current understanding, approach, and methods used to identify and map GDEs in the Santa Clara and Llagas subbasins is included in Appendix G of the 2021 GWMP.

Recommended Action 2

Section 4.5 Climate Change Impacts on Groundwater Budget of the 2021 GWMP includes an analysis of projected groundwater budget considering climate change for the year 2045. This analysis focuses on 2045 to stay consistent with other Valley Water planning documents, including the 2020 Urban Water Management Plan. During the next five-year update cycle of the GWMP, Valley Water plans to conduct a more integrated analysis of climate change impacts that also considers projected climate change impacts on imported water supply.

Recommended Action 3

Section 5.4 Outcome Measures of the 2021 GWMP includes new and separate outcome measures related to water quality in the Santa Clara and Llagas subbasins. These separate subbasin-specific criteria will allow for a determination of whether each subbasin, separately, is meeting or making progress toward the outcome measures. The new water quality outcome measure for the Santa Clara Subbasin is distinctly different than the new outcome measure for seawater intrusion in the subbasin, as described below.

Recommended Action 4

Section 5.4 Outcome Measures of the 2021 GWMP includes new outcome measure-lower thresholds for each of the five corresponding outcome measures in the Santa Clara and Llagas subbasins. These outcome measure-lower thresholds are designed to be functionally equivalent to a minimum threshold and thus help define undesirable results for each corresponding sustainability indicator. Additional details are provided in section 5.4 of the 2021 GWMP.

Recommended Action 5

Section 5.4 Outcome Measures of the 2021 GWMP includes a new seawater intrusion outcome measure for the Santa Clara Subbasins. A detailed technical memorandum that documents the current understanding of seawater intrusion mechanisms, approach, and analysis used to develop the seawater intrusion outcome measure is included in Appendix H of the 2021 GWMP. This memo also documents current understanding of climate change driven sea-level rise and implications for monitoring and managing seawater intrusion in the Santa Clara Subbasin.

Appendix C – Response to DWR Recommended Actions

Appendix C-1 and C-2

Appendix C-1 is the DWR cover letter and Alternative Assessment Staff Report for the Santa Clara Subbasin.

Appendix C-2 is the DWR cover letter and Alternative Assessment Staff Report for the Llagas Subbasin.

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CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE
901 P Street, Room 313-B | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

July 17, 2019

Ms. Vanessa De La Piedra
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, California 95118

Dear Ms. De La Piedra,

The Department of Water Resources (Department) has evaluated the alternative submitted for the Santa Clara Subbasin. Based on recommendations from the Staff Report, included as an exhibit in the attached Statement of Findings, the Department has determined that the Santa Clara Alternative satisfies the objectives of the Sustainable Groundwater Management Act (SGMA) and is approved. The Staff Report also proposes recommended actions for the consideration of the Santa Clara Valley Water District that the Department believes will enhance the Alternative and facilitate future evaluation by the Department. The recommended actions do not constitute a qualified approval of the Alternative; however, the Department encourages they be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates.

As required by SGMA, the Department shall review approved alternatives to ensure they remain in compliance with the objectives of the Act. Approved alternatives are required to submit annual reports to the Department on April 1 of each year, and to resubmit the alternative by January 1 every five years. The first five-year update is due by January 1, 2022.

Please contact me at (916) 651-0870 or Craig.Altare@water.ca.gov if you have any questions related to the Department's evaluation or your implementation of the approved alternative.

Thank You,

Craig Altare, P.G.
Supervising Engineering Geologist

Attachments:

1. Statement of Findings Regarding the Approval of the Santa Clara Subbasin Alternative

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Alternative Assessment Staff Report

Groundwater Basin Name:	Santa Clara Valley – Santa Clara (Basin No. 2-009.02)
Submitting Agency:	Santa Clara Valley Water District
Recommendation:	Approve
Date Issued:	July 17, 2019

I. Summary

The Santa Clara Valley Water District (District) submitted an alternative (Santa Clara Alternative or Alternative) to the Department of Water Resources (Department) for evaluation and assessment as provided by the Sustainable Groundwater Management Act (SGMA).[1] The District submitted an existing plan, which relies primarily on the District's 2016 Groundwater Management Plan (Groundwater Management Plan or Plan).[2]

The District was formed in 1929, following enactment of the first voter-approved groundwater protection law in Santa Clara County. The law charged the District with the responsibility of stopping groundwater overdraft and subsidence in accordance with the Santa Clara Valley Water District Act (District Act).[3] The District manages water resources for the entire County, which includes two groundwater subbasins, the Santa Clara Subbasin of the Santa Clara Valley Groundwater Basin (Santa Clara Subbasin *or* Subbasin) and the Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin. The District's Groundwater Management Plan includes both subbasins.[4]

The Alternative demonstrates a long history of implementing the requirements of the District Act. The District has done this by developing a good understanding of the hydrogeologic conditions of the Subbasin, establishing significant water imports, and managing those resources to meet the demands of the beneficial uses and users. The

[1] Water Code § 10720 *et seq*.
[2] Water Code § 10733.6(b)(1)
[3] Wat. Code, § App. § 60-1 *et seq*. (Stats.1951, c. 1405, p. 3337)
[4] The District submitted the 2016 Groundwater Management Plan as an Alternative for both the Santa Clara and Llagas subbasins. This assessment is specifically related to the Department's review for the Santa Clara Subbasin.

District has conducted numerous studies to identify appropriate actions to capture surface water runoff and store it for the purposes of replenishment of the groundwater. The quantification of required volumes, timing, and distribution of recharge have resulted in management of the Subbasin that has avoided overdraft and subsidence. The District's Groundwater Management Plan has established objectives to maintain the avoidance of adverse groundwater conditions in the Subbasin and documents specific plans and management actions to achieve those objectives. These plans and management actions are based on proven technologies, are reasonable and feasible, and present solutions to meet the objectives of the District Act.

Based on review of the Groundwater Management Plan, other related documents, and consideration of public comments, Department staff believe the Santa Clara Alternative satisfies the objectives of SGMA for the Santa Clara Subbasin and recommends approval of the Alternative. Staff consider the information provided by the District to be sufficient and credible, and that implementation of the District's Groundwater Management Plan is reasonably likely to lead to sustainable groundwater management[5] of the Subbasin. In addition, staff have identified recommended actions that are designed to facilitate the Department's ongoing evaluation and assessment of the Alternative including implementation and a determination of whether the Alternative continues to satisfy the objectives of SGMA or adversely affects an adjacent basin.

The remainder of this assessment is organized as follows:

- **Section II. Review Principles** describes legal and other considerations regarding Department staff's assessment and evaluation of alternatives.
- **Section III. Alternative Materials** describes materials (i.e., plans, reports, data, and other information) submitted by the Agency that, collectively, the Department staff considered as the Alternative.
- **Section IV. Required Conditions** describes whether the Alternative satisfies each of the four conditions required for the Department to review an alternative.
- **Section V. Alternative Contents** describes the information contained in the Alternative submittal.
- **Section VI. Assessment** describes Department staff's evaluation of the Alternative, whether it satisfies the objectives of SGMA, and, if applicable, describes recommended actions proposed for the first five-year update.

[5] Water Code § 10721(v). See also discussion in Section II. Review Principles. Sustainable groundwater management is achieved by meeting the basin's sustainability goal.

II. Review Principles

The District submitted an alternative based on a groundwater management plan to the Department for evaluation and assessment to determine whether it satisfies the objectives of SGMA for the Santa Clara Subbasin. To satisfy the objectives of SGMA, an alternative based on a groundwater management plan prepared pursuant to Part 2.75 of Division 6 of the Water Code[6] or a plan developed pursuant to another law authorizing groundwater management must demonstrate that implementation of the plan has led to or will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[7] Undesirable results are defined quantitatively by the managing agency.[8]

An alternative, to be evaluated by the Department, must be submitted by the statutory deadline and be within a basin that complies with Part 2.11 of Division 6 of the Water Code.[9] The submitted alternative must also be complete and must cover the entire basin.[10] The Groundwater Sustainability Plan (GSP) Regulations[11] require the Department to evaluate an Alternative "in accordance with Sections 355.2, 355.4(b), and Section 355.6, *as applicable*, to determine whether the Alternative complies with the objectives of the Act".[12] The elements of the cited sections are not all applicable to alternatives. Some provisions apply to GSPs and alternatives alike, to alternatives only prospectively, or do not apply to alternatives at all.[13] Ultimately, the purpose of the evaluation is to determine whether an alternative satisfies the objectives of SGMA.[14] The agency must explain how the elements of an alternative are "functionally equivalent" to the elements of a GSP required by Articles 5 and 7 of the GSP Regulations and are

[6] Water Code § 10750 *et seq.*
[7] Water Code § 10721(v)
[8] 23 CCR § 354.26
[9] Water Code § 10733.6(c)-(d)
[10] 23 CCR § 358.4(a)
[11] 23 CCR § 350 *et seq.*
[12] 23 CCR § 358.4(b) (emphasis added)
[13] Procedural requirements, including submissions by the agency, posting by the Department, and the public comment period, apply equally to plans and alternatives (23 CCR § 355.2(a)-(c)). The periodic review of Plans (23 CCR § 355.6(a)) applies to alternatives prospectively but does not apply to initial submissions. Other regulatory provisions are inapplicable to alternatives, including the two-year review period (23 CCR § 355.2(e)), which is based on the statutory time-frame that applies to Plans but not alternatives (Water Code § 10733.4(d)); the "incomplete" status that allows the agency to address "one or more deficiencies that preclude approval, but which may be capable of being corrected by the Agency in a timely manner" (23 CCR § 355.2(e)(2)), which applies to plans undergoing development, but not alternatives that purportedly satisfy the objectives of SGMA at the time of their submission (Water Code § 10733.6(a)); and, for the same reason, corrective actions to address deficiencies in plans (23 CCR § 355.4(a)(4)), which applies to plans developed after the adoption of SGMA, but is inapplicable to alternatives that predate SGMA.
[14] 23 CCR § 358.2(d), based on the statutory threshold of "whether the alternative satisfies the objectives of [SGMA] for the basin" (Water Code § 10733.6(a)).

sufficient to demonstrate the ability of an alternative to achieve the objectives of SGMA.[15] The explanation by the agency that elements of an alternative are functionally equivalent to elements of a GSP furthers the objective of demonstrating that an alternative satisfies the objectives of SGMA. Alternatives based on groundwater management plans or historical basin management practices that predate the passage of SGMA or adoption of GSP Regulations, although required to satisfy the objectives of SGMA, are not necessarily expected to conform to the precise format and content of a GSP. The Department's assessment is thus focused on the ability of an alternative to satisfy the objectives of SGMA as demonstrated by information provided by the agency; it is not a determination of the degree to which an alternative matched the specific requirements of the GSP Regulations.

When evaluating whether an alternative satisfies the objectives of SGMA and thus is likely to achieve the sustainability goal for the basin, staff review the information provided by and relied upon by the agency for sufficiency, credibility, and consistency with scientific and engineering professional standards of practice.[16] The Department's review considers whether there is a reasonable relationship between the information provided and the assumptions and conclusions made by the agency, whether sustainable management criteria and projects and management actions described in an alternative are commensurate with the level of understanding of the basin setting, and whether those projects and management actions are feasible and likely to prevent undesirable results.[17] Staff will recommend that an alternative be approved if staff believe, in light of these factors, that alternative has achieved or is likely to achieve the sustainability goal for the basin.[18]

An alternative that relies on an existing plan may be approved based on information that demonstrates the basin is being or will be managed sustainably based on groundwater management pursuant to that plan, including any related projects and management actions, as necessary. Even when staff review indicates that an alternative will satisfy the objective of SGMA, the Department may recommend actions to facilitate future evaluation of that alternative and to allow the Department to better evaluate whether an alternative adversely affects adjacent basins. The Department proposes that recommended actions be addressed by the submission date for the first periodic evaluation.

Staff assessment of an alternative involves the review of information presented by the agency, including models and assumptions, and an evaluation of that information based on scientific reasonableness. The assessment does not require Department staff to recalculate or reevaluate technical information provided in an alternative or to perform its

[15] 23 CCR § 358.2(d)
[16] 23 CCR § 351(h)
[17] 23 CCR § 355.4(b)(1), (3), and (5).
[18] 23 CCR § 355.4(b)

own geologic or engineering analysis of that information. The staff recommendation to approve an alternative does not signify that Department staff, were they to exercise the professional judgment required to develop a plan for the basin, would make the same assumptions and interpretations as those contained in an alternative, but simply that Department staff have determined that the assumptions and interpretations relied upon by the submitting agency are supported by adequate, credible evidence, and are scientifically reasonable.

III. Alternative Materials

The District submitted an alternative based on a groundwater management plan pursuant to Water Code Section 10733.6(b)(1). The Alternative thus relies primarily upon the following document:

- Santa Clara Valley Water District 2016 Groundwater Management Plan, November 2016 (Groundwater Management Plan or Plan)

The District submitted the following additional plans, reports, and other documents prepared prior to the implementation of SGMA that the Department has determined to be sufficiently related to the Groundwater Management Plan to warrant their consideration as part of the Alternative:

- Santa Clara Valley Water District, 2016, Annual Groundwater Report for Calendar Year 2015 (2015 Annual Report)
- Santa Clara Valley Water District, June 2016, Revised Final Salt and Nutrient Management Plan (Salt and Nutrient Management Plan)
- Santa Clara Valley Water District, 2016, 2015 Urban Water Management Plan (2015 Urban Water Management Plan)
- Santa Clara Valley Water District, Online – Historical Groundwater Elevation Data, https://gis.valleywater.org/groundwaterelevations/map.php
- Santa Clara Valley Water District Act (District Act), https://www.valleywater.org/how-we-operate/about-the-water-district/district-act

The District submitted a Groundwater Management Plan Appendix B - Demonstration of Functional Equivalency of the Alternative to address the required Alternative Elements Guide. The Agency has also submitted Annual Reports.[19] Other material submitted by the District, public comments, other documents submitted by third parties,

[19] The Annual Report is not part of the Alternative and was not reviewed by the Department for the purpose of approving the Alternative.

correspondence, and other information provided to or relied upon by the Department have been posted on the Department's website.[20]

IV. Required Conditions

An alternative, to be evaluated by the Department, must be submitted by the statutory deadline and be within a basin that complies with Part 2.11 of Division 6 of the Water Code.[21] The submitted alternative must also be complete and must cover the entire basin.[22]

A. Submission Deadline

SGMA requires that an alternative for a basin categorized as high- or medium-priority as of January 31, 2015, be submitted no later than January 1, 2017.[23]

The District submitted its Alternative on December 21, 2016, before the statutory deadline.

B. Part 2.11 (CASGEM) Compliance

SGMA requires that the Department assess whether an alternative is within a basin that is in compliance with Part 2.11 of Division 6 of the Water Code,[24] which requires that groundwater elevations in all groundwater basins be regularly and systematically monitored and that groundwater elevation reports be submitted to the Department.[25] To manage its obligations under this law, the Department established the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. The acronym CASGEM is used in this document to denote both the program and the groundwater monitoring law.[26]

SGMA specifies that an alternative does not satisfy the objectives of SGMA if the basin is not in compliance with the requirements of CASGEM.[27] The Department confirmed that the Santa Clara Subbasin was in compliance with the requirements of CASGEM prior to evaluating the Alternative and confirmed that the Subbasin remained in compliance with CASGEM through the last reporting deadline prior to issuing this assessment.

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[20] https://sgma.water.ca.gov/portal/alternative/print/18
[21] Water Code § 10733.6(c)-(d)
[22] 23 CCR § 358.4(a)
[23] Water Code § 10733.6(c). Pursuant to Water Code § 10722.4(d), a different deadline applies to a basin that has been elevated from low- or very low-priority to high- or medium-priority after January 31, 2015.
[24] Water Code § 10733.6(d)
[25] Water Code § 10920 *et seq*.
[26] Stats.2009-2010, 7th Ex.Sess., c. 1 (S.B.6), § 1
[27] Water Code § 10733.6(d)

C. Completeness

GSP Regulations specify that the Department shall evaluate an alternative if that alternative is complete and includes the information required by SGMA and the GSP Regulations.[28] An alternative submitted pursuant to Water Code Section 10733.6(b)(1) must include a copy of the groundwater management plan and an explanation of how the elements of the Alternative are functionally equivalent to the elements of a GSP required by Articles 5 and 7 of the GSP Regulations and are sufficient to demonstrate the ability of the Alternative to achieve the objectives of SGMA.[29]

The District submitted a completed and final Groundwater Management Plan for the Santa Clara Subbasin, complementary documents, as indicated above, and other materials as required. Department staff found the Alternative to be complete and containing the required information, sufficient to warrant an evaluation by the Department.

D. Basin Coverage

An alternative must cover the entire basin.[30] An alternative that is intended to cover the entire basin may be presumed to do so if the basin is fully contained within the jurisdictional boundaries of the submitting agency.

The jurisdictional boundaries of the District cover the entire Santa Clara Subbasin.[31] The Districts' authority aligns with Santa Clara County's jurisdictional boundaries and wholly cover the Santa Clara Subbasin.

V. Alternative Contents

GSP Regulations require the submitting agency to explain how the elements of an alternative are functionally equivalent to the elements of a GSP as required by Article 5 of the GSP Regulations[32] and are sufficient to demonstrate the ability of an alternative to achieve the objectives of SGMA.[33]

As stated previously, alternatives based on historical basin management practices that predate the passage of SGMA or adoption of GSP Regulations, although required to satisfy the objectives of SGMA, are not necessarily expected to conform to the precise format and content of a GSP, and the criteria for adequacy of an alternative is whether

[28] 23 CCR § 358.4(a)(3)
[29] 23 CCR § 358.2(c)-(d)
[30] 23 CCR § 358.4(a)(4)
[31] SGMA Alternative Portal, Attachment B-3 (https://sgma.water.ca.gov/portal/alternative/print/18)
[32] 23 CCR § 354-354.44
[33] 23 CCR § 358.2(d). The requirements pertaining to Article 7 of the GSP Regulations (23 CCR § 356-356.4) relate to annual reports and periodic evaluation and are not applicable to review of the initial alternative.

the Department is able to determine that an alternative satisfies the objectives of SGMA. Department staff rely on the submitting agency's determination of functional equivalence of alternative elements to facilitate its evaluation and assessment of an alternative (*see* Assessment, below). Although the exact components of a GSP are not required for an alternative, for organizational purposes the discussion of information contained in the Groundwater Management Plan and related documents provided by the District generally follows the elements of a GSP provided in Article 5 of the GSP Regulations. The reference to requirements of the GSP Regulations at the beginning of each section is to provide context regarding the nature of the element discussed but is not meant to define a strict standard applicable to alternatives.

A. Administrative Information

GSP Regulations require information identifying the submitting agency, describing the plan area, and demonstrating the legal authority and ability of the submitting agency to develop and implement a plan for that area.[34]

The Groundwater Management Plan contains information describing the history, governance structure, and financial capabilities for the District.[35] The Plan describes the structure the District, a water wholesaler, uses to engage with the various water retailers, land use agencies, local, state, and federal agencies, and other stakeholders. A discussion with supporting documentation of the specific public outreach conducted as part of the Plan development is also provided.[36]

The District Act, established in 1929 to address the primary objectives of overdraft and subsidence, provides the District with the statutory authority to manage groundwater in the county, identifies the consideration of all beneficial uses and users, and defines the primary objectives for the Subbasin.[37] The description of the administration and groundwater management associated with the District Act implementation includes an overview of decades of engagement by a public agency responsible for managing the groundwater and surface water resources of the basin. The District determined that, to meet water demand in the basin and avoid adverse conditions, additional supply was necessary and developed agreements to receive surface waters from the San Francisco Public Utility Commission and the Central Valley Project through a series of projects to store and distribute these waters.[38] The Plan also describes the District's ability to adapt to changing demands and conditions in the basin, such as the evolution of land use from agricultural to urban and industrial, with concomitant changes to water quality protection

[34] 23 CCR § 354.2 et seq.
[35] Groundwater Management Plan, Section 1-4, p. 1-3
[36] Groundwater Management Plan, Appendix A, p. A-1
[37] District Act, Section 5(5)
[38] Groundwater Management Plan Section 1.4.1, p. 1-8

efforts including hazardous materials storage permit requirements.[39] Other examples include conservation programs, recycled water programs, and cooperative engagement with the Regional Water Quality Control Boards to address point source contaminants from leaky underground storage tank sites and other significant industrial contaminant release sites.[40]

B. Basin Setting

GSP Regulations require information about the physical setting and characteristics of the basin and current conditions of the basin, including a hydrogeologic conceptual model, a description of historical and current groundwater conditions, and an assessment of the water budget.[41]

1. Hydrogeologic Conceptual Model

The GSP Regulations require a descriptive hydrogeologic conceptual model of the basin that includes a written description supported by cross sections and maps.[42]

The Groundwater Management Plan includes a hydrogeologic conceptual model that describes the lateral and vertical extents of the Subbasin, recharge areas, principal aquifers and aquitards, and significant faults within the basin.[43] The basin is situated between faults associated with the San Andreas system and generally drains from south to north into the San Francisco Bay. The District has subdivided the Santa Clara Subbasin into two primary management areas: the Santa Clara Plain area and the Coyote Valley area[44] (*see* Management Areas, below). Figure 1 illustrates the relationship of the Santa Clara Plain area and Coyote Valley area including confined and recharge areas, and location of cross section line A-A'.

[39] Groundwater Management Plan Section 1.4.1, p. 1-9
[40] Groundwater Management Plan Section 1.4.1, p. 1-7
[41] 23 CCR § 354.12 et seq.
[42] 23 CCR § 354.14(a)
[43] Groundwater Management Plan, Section 2.1, p. 2-1
[44] Groundwater Management Plan, Section 2.1, p. 2-1

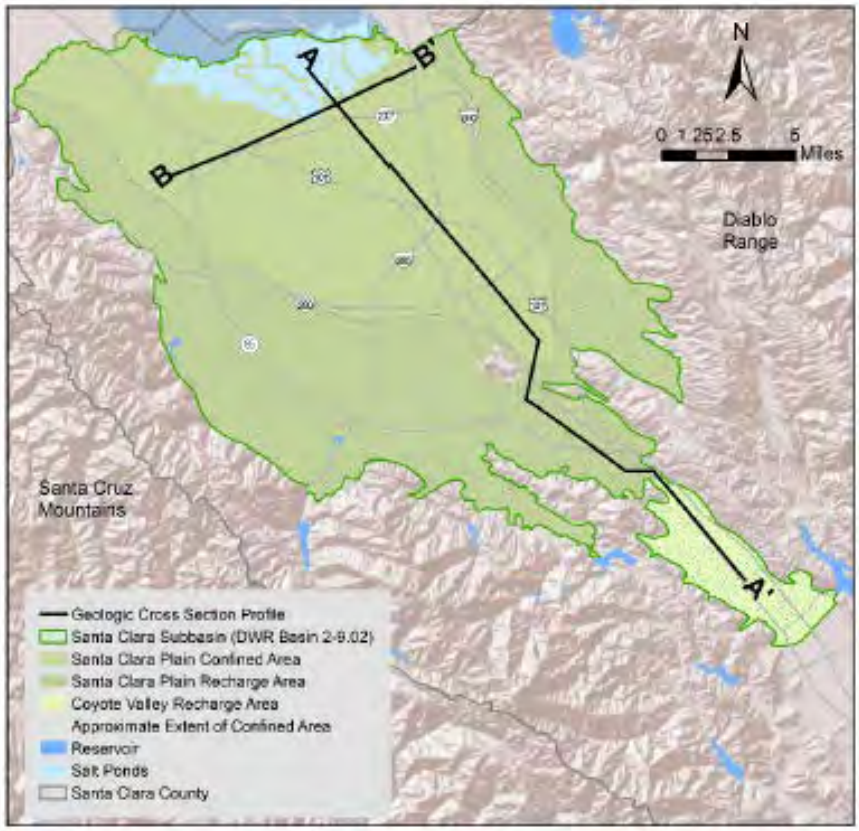

Figure 1 - Cross-Section Locations (Figure 2-3 of Groundwater Management Plan)

These two areas differ in geology, hydrology, land use, and water use. The Plan describes the Coyote Valley area as being in the southern portion of the basin with groundwater flowing northward through a bedrock constriction into the Santa Clara Plain area.[45] The Santa Clara Plain area is described as containing two significant aquifers, identified as the "shallow aquifer zone" and the "principal aquifer zone", which are separated by an aquitard and are generally dipping toward the bay.[46] The Coyote Valley area is characterized by unconsolidated sand and gravels with discontinuous clays. Figure 2 presents cross-section A-A' which illustrates the relationship of the shallow aqufier zone, major aquitard, and principal aquifer zone for the Coyote Valley and Santa Clara Plain areas, and also shows the general dip toward the north and San Francisco Bay.[47] The Plan provides maps of the depth to bedrock based on geophysical and borehole cutting analysis and characterizes the Subbasin as ranging in depth from approximately 150 feet in Coyote Valley area to approximately 1,500-feet deep in the center of the Santa Clara Plain area.[48] The Plan describes the recharge areas as occurring where the principal

[45] Groundwater Management Plan, Section 2.2.1, p. 2-9
[46] Groundwater Management Plan Section 2.1.3, p. 2-3
[47] Groundwater Management Plan, pp. 2-4 through 2-6 and Figures 2-3, 2-4, and 2-5
[48] Groundwater Management Plan Section 2.1.4, p. 2-7

aquifer zone is generally unconfined - along the margins of the basin - allowing for percolation of water into the strata that dip northward and continuing into areas that are overlain by a fine grained confining layer in the center of the basin.

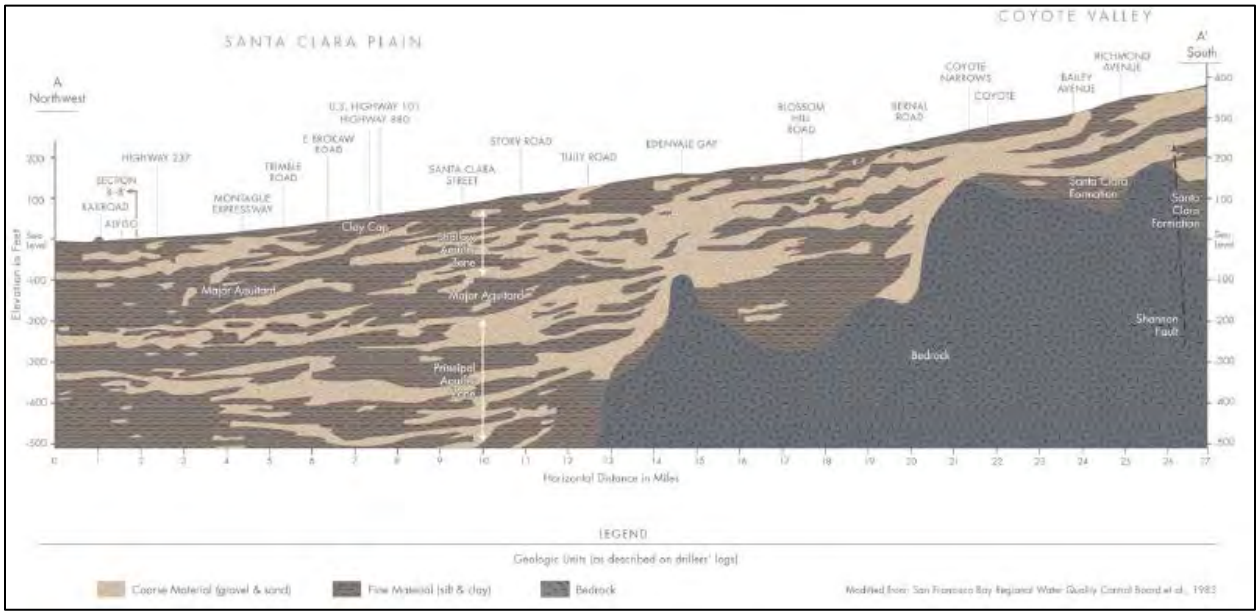

Figure 2 - Cross-Section A-A' (Fig 2-4 of Groundwater Management Plan)

2. Groundwater Conditions

The GSP Regulations require a description of historical and current groundwater conditions in the basin that includes information related to groundwater elevations, groundwater storage, seawater intrusion, groundwater quality, subsidence, and interconnected surface water, as applicable. The GSP Regulations also require an identification of groundwater dependent ecosystems.[49]

The Groundwater Management Plan characterizes current and historical groundwater conditions including groundwater elevations, land subsidence, surface water and groundwater interactions, water quality, and seawater intrusion. [50] Additional and supporting information regarding groundwater conditions in the Subbasin are provided in the 2015 Annual Report, online Historical Groundwater Elevation Data, Salt and Nutrient Management Plan, and the 2015 Urban Water Management Plan which were submitted to the Department as part of the Alternative.

Groundwater elevation information is presented in the Plan based upon a monitoring network that collects information on water quality, water elevation, and subsidence (*see* Monitoring Network, below). The District compiles data from its monitoring network to

[49] 23 CCR § 354.16
[50] Groundwater Management Plan, Section 2.2, p. 2-9

produce groundwater elevation contour maps and hydrographs that illustrate small-scale variations in groundwater conditions of the principal aquifer zone. The District provides information about current groundwater elevations in contour maps representing spring and fall conditions from its most recent annual report,[51] and provides maps from 2012 in the Plan, which the District describes as characterizing "typical" basin conditions.[52] These maps illustrate the general groundwater flow directions and gradients within the principal aquifer zone and the change in seasonal flow patterns associated with recharge operations and typical pumping conditions and depressions. The Plan and the 2015 Annual Report also provide hydrographs for index wells from pre-1950 to present.[53] Each of the index wells have long periods of record and are described as being representative of the general aquifer response in Coyote Valley and Santa Clara Plain areas. Historical Groundwater Elevation Data, showing groundwater elevation trends for the wells monitored in the basin, is made available online for public review.[54]

The District estimated the operational storage capacity for the Santa Clara Plain area to be 350,000 acre-feet and estimated a range from 23,000 to 33,000 acre-feet for the Coyote Valley Area. The Subbasin has a total estimated groundwater storage of 1.9 million acre-feet; however, much of this total is deemed inaccessible by the District using wells without causing undesirable results. The storage estimates are based on numerical modeling studies that describe the annual change in storage from 1970 to 2016 and from 1987 to 2016 in the Santa Clara Plain and Coyote Valley areas, respectively.[55]

The District describes seawater intrusion as impacting the Santa Clara Plain area, but not the Coyote Valley area which is isolated inland and outside the potential for seawater intrusion conditions (see Figure 2). Within the Santa Clara Plain area, the District describes seawater intrusion as most prevalent in the shallow aquifer zone which is believed to be impacted by saline water intruding through interconnected intertidal salt marshes and creeks on the flanks of the bay. The District conducts regular monitoring and tracking of chloride concentrations in the shallow aquifer zone.[56] Impacts to the principal aquifer zone are believed to be from old poorly constructed wells that penetrate the shallow and principal aquifer zones, allowing for vertical migration of seawater.[57] The hydrogeologic conceptual model referenced above describes the extent of bay muds that isolate the principal aquifer zone strata from direct connection with seawater in the bay. The District also describes chloride concentrations in the principal aquifer zone as relatively low, but specific information regarding the extent of impacts were not included.

[51] 2015 Annual Groundwater Report, Figures 14, 15, 16, pp. 21-23
[52] Groundwater Management Plan, Section 2.2.1 p. 2-9
[53] Groundwater Management Plan, Section 2.2.1 p. 2-11
[54] Historical Groundwater Elevation Data, https://gis.valleywater.org/GroundwaterElevations/map.php
[55] Groundwater Management Plan, Section 4.4.1.3, p. 4-11
[56] Groundwater Management Plan, Section 2.2.5, p. 2-29
[57] Groundwater Management Plan, Section 2.2.5, p. 2-29

According to the District, chloride isoconcentration contours for 1945, 1980, and 2015 demonstrate a progressive retreat of the chloride contour following the import of Central Valley Project water in the 1980's.[58]

Other groundwater quality issues have evolved as the Santa Clara Subbasin has changed from an agricultural area to an industrial and urban one.[59] Water quality issues affecting groundwater include contaminants from legacy agriculture, domestic septic discharges, and industrial chemical and waste releases. The District coordinates with federal and state agencies to address known point source contaminants and aids with legacy domestic nitrate concerns. The Plan characterizes the water quality conditions within the Santa Clara and Coyote Valley areas from the period of 2006 to 2015, although water quality conditions in the Santa Clara and Coyote Valley areas have been monitored and managed for decades.[60] The water quality data presented is based on ongoing monitoring conducted by the District and its member agencies, including data reported to the State Water Resources Control Board, Division of Drinking Water to provide a spatially distributed understanding of water quality. The Plan identifies the distribution of key constituents with respect to the maximum contaminant level (MCL) and secondary maximum contaminant level (SMCL) from 2006 to 2015.[61] Tabular water quality summary information for organic and inorganic constituents of the Santa Clara Plain and Coyote Valley areas provide a generalized 10-year perspective of the distribution and relative exceedances of primary and secondary MCLs.[62]

In association with the District's recycled water program, a detailed analysis of the Subbasin-wide salt and nutrient loading was presented in the Salt and Nutrient Management Plan. The Salt and Nutrient Management Plan was prepared with respect to the San Francisco Water Quality Control Board's Basin Plan objectives for all beneficial uses and users. The Salt and Nutrient Management Plan presents additional information regarding the existing distribution of total dissolved solids and nitrates and impacts associated with additional salt and nutrient loading within the basin using an assimilative capacity analysis.[63] The Groundwater Management Plan provides a map of locations of known contaminated sites managed by other regulatory agencies.[64]

The Plan states that the Santa Clara Valley was the first area in the United States where permanent land subsidence due to groundwater withdrawal was recognized. Land subsidence was a driving force behind the District Act, whose purposes included to address overdraft, subsidence, and increased potential and occurrence of flooding

[58] Groundwater Management Plan, Figure 2-21, p. 2-30
[59] Groundwater Management Plan, Section 1.5.2, p. 1-15
[60] Groundwater Management Plan, Section 2.2.2, p. 2-12
[61] Groundwater Management Plan, Figures 2-18 and 2-19, p. 2-20
[62] Groundwater Management Plan, Section 2.2.4, p. 2-28
[63] Salt and Nutrient Management Plan, Section 3.4.5.7, p. 83
[64] Groundwater Management Plan, Figure 6-1, p. 6-16

because of subsidence. [65] The Groundwater Management Plan notes that subsidence in the Santa Clara Subbasin has been a significant issue in the past, but explains that whereas subsidence has been documented in the Santa Clara Plain area, it is absent from the Coyote Valley area due to geologic differences in the two areas. Basin fill in the Santa Clara Plain area consists of discontinuous sand lenses and fine-grained clay and muds which are subject to compaction due to groundwater extraction, whereas the Coyote Valley area contains predominantly coarser grained sands and gravel basin fill, with significantly less fine-grained material susceptible to compaction that causes subsidence(See Figure 2 above).[66] The Plan provides analysis of the spatial distribution of total subsidence that has occurred in the Subbasin as well as the remaining potential for subsidence[67] and describes how additional detailed studies have established specific groundwater levels at key wells to avoid conditions when subsidence has been observed (*see* Land Subsidence, below).

As described in the Groundwater Management Plan, the District utilizes the creeks and streams as part of its management practices to recharge groundwater in the Subbasin.[68] The District describes that its recharge activities are an important factor in maintaining flows in the surface water bodies in the Subbasin, many of which would only flow intermittently in the absence of that recharge.[69] The District has identified relatively short stream segments with suspected groundwater-surface water interactions on the margins of the basin,[70] and stated they were not aware of any areas where groundwater pumping has a significant or unreasonable effect on interconnected surface water.[71] The Plan provides a historical ecology map described as representing conditions from “circa the early 1800s” depicting the distribution of vegetative communities and the occurrence of historical intermittent and perennial creeks.[72] The Plan describes that historically, only the Guadalupe River was perennial and other creeks were intermittent.

3. Water Budget

GSP Regulations require a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored, as applicable.[73]

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[65] Groundwater Management Plan, Section 2.2.2, p. 2-12
[66] Groundwater Management Plan, Section 2.2.2, p. 2-13
[67] Groundwater Management Plan, Section 2.2.2, p. 2-13
[68] Groundwater Management Plan, Section 2.2.3, p. 2-17
[69] Groundwater Management Plan, Section 2.2.3, p. 2-14
[70] Groundwater Management Plan, Figure 2-14, p. 2-15
[71] Groundwater Management Plan, Section 2.2.3, p. 2-14
[72] Groundwater Management Plan, Section 2.2.3, p. 2-16
[73] 23 CCR § 354.18

The Groundwater Management Plan provides a description of the countywide water supplies, use, and management for the Santa Clara Subbasin.[74] The Plan also provides a detailed quantification of the groundwater budget summarizing natural and managed inflows and outflows for a period of 2003 through 2012. The District selected this 10-year period as representing dry, wet, and normal years, without incorporating recent periods of exceptionally dry years.[75] A summary of the water budget over this period indicates the Santa Clara Plain area and the Coyote Valley area have an average annual change in storage of positive 2,000 and 500 acre-feet per year, respectively.[76] The District utilizes groundwater models to support development of the groundwater budget in conjunction with monitoring data.[77] The models provide a quantification of groundwater flow, recharge, and discharge conditions for both the Santa Clara Plain area and the Coyote Valley area. Projected water budget is described in the Groundwater Management Plan and the 2015 Urban Water Management Plan. The Groundwater Management Plan describes increasing demand in both the Santa Clara Plain and Coyote Valley areas.[78] Climate change is indirectly addressed in the 2015 Urban Water Management Plan acknowledging that climate change is expected to have an effect on future water supply and demands, but due to viability of the current hydrology it is difficult to quantify climate change impact on future year demands.[79] The 2015 Urban Water Management Plan provides descriptions of projected water demand through 2040 for various water use sectors and are summarized in Table 4-1 and Figure 4-5, which indicate an anticipated steady increase in population and water use dominated by water retailer water use increases.[80]

4. Management Areas

GSP Regulations authorizes, but does not require, an agency to define one or more management areas within a basin if the agency has determined that creation of management areas will facilitate implementation of the GSP.[81]

The District has identified two management areas in the Santa Clara Subbasin: the Santa Clara Plain area and the Coyote Valley area. These areas are based on significant differences in geologic setting, land use, and water use (*see* Hydrogeologic Conceptual Model, above). The District considers these as discrete areas for quantification of water

[74] Groundwater Management Plan, Sections 4.1 – 4.3, p. 4-1
[75] Groundwater Management Plan, Section 4.4, p. 4-7
[76] Groundwater Management Plan, Section 4.4.1.4, p. 4-12
[77] Groundwater Management Plan, Section 4.4.1.3, p. 4-11
[78] Groundwater Management Plan, Section 4.5, p. 4-17
[79] 2015 Urban Water Management Plan, Section 4.4, p. 4-8
[80] 2015 Urban Water Management Plan, Section 4.2, p. 4-2
[81] 23 CCR § 354.20

budget, groundwater monitoring, and for setting specific sustainable management criteria.

C. Sustainable Management Criteria

GSP Regulations require a sustainability goal that defines conditions that constitute sustainable groundwater management for the basin, the characterization of undesirable results, and establishment of minimum thresholds and measurable objectives for each applicable sustainability indicator, as appropriate.[82]

1. Sustainability Goal

GSP Regulations require that sustainable management criteria include a sustainability goal that culminates in the absence of undesirable results within the appropriate timeframe, and includes a description of the sustainability goal, describes information used to establish the goal for the basin, describes measures that will be implemented to ensure the basin operates within its sustainable yield, and contains an explanation of how the sustainability goal will be met.[83]

The Groundwater Management Plan describes the correlation of the sustainable management criteria defined in SGMA with the driving principles of the District Act.[84] The Plan identifies two sustainability goals: (1) "groundwater supplies are managed to optimize water supply reliability and minimize subsidence", and (2) "groundwater is protected from contamination, including salt water intrusion."[85] The implementation of groundwater management activities associated with the District Act resulted in establishing organizational terminology and policy to implement the necessary actions to achieve these objectives. Figure 5-1 and 5-2 of the Plan illustrate the policy framework and definitions of the sustainability goals down to specific measurable outcomes.[86]

2. Sustainability Indicators

GSP Regulations specify that an agency define conditions that constitute sustainable groundwater management for a basin, including the characterization of undesirable results and the establishment of minimum thresholds and measurable objectives for each applicable sustainability indicator.[87]

Sustainability indicators are defined as any of the effects caused by groundwater conditions occurring throughout the basin that, *when significant and unreasonable*, cause

[82] 23 CCR § 354.22
[83] 23 CCR § 354.24
[84] Groundwater Management Plan, Section 5.1, p. 5-1
[85] Groundwater Management Plan, Section 5.2, p. 5-2
[86] Groundwater Management Plan, Section 5.1, p. 5-1
[87] 23 CCR § 354.22

undesirable results.[88] Sustainability indicators thus correspond with the six undesirable results – chronic lowering of groundwater levels indicating a depletion of supply if continued over the planning and implementation horizon, reduction of groundwater storage, seawater intrusion, degraded water quality, including the migration of contaminant plumes that impair water supplies, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have adverse impacts on beneficial uses of the surface water[89] – but refer to groundwater conditions that are not, in and of themselves, significant and unreasonable. Rather, sustainability indicators refer to the effects caused by changing groundwater conditions that are monitored, and for which criteria in the form of minimum thresholds are established by the agency to define when the effect becomes significant and unreasonable, producing an undesirable result.

This section thus consolidates three facets of sustainable management criteria: undesirable results, minimum thresholds, and measurable objectives. Information pertaining to the processes and criteria relied upon to define undesirable results applicable to the basin, as quantified through the establishment of minimum thresholds, are addressed for each sustainability indicator. However, a submitting agency is not required to establish criteria for undesirable results that the agency can demonstrate are not present and are not likely to occur in a basin.[90]

a. Chronic Lowering of Groundwater Levels.

GSP Regulations specify that the minimum threshold for chronic lowering of groundwater levels be based on groundwater elevations indicating a depletion of supply that may lead to undesirable results.[91]

The Plan describes that the District developed groundwater-level-based thresholds for the avoidance of land subsidence in 1991 and has since managed the Subbasin to those levels.[92] Description of those thresholds is provided below (*see* Land Subsidence).

b. Reduction of Groundwater Storage

GSP Regulations specify that the minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results.[93]

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[88] 23 CCR § 351(ah)
[89] Water Code § 10721(x)
[90] 23 CCR § 354.26(d)
[91] 23 CCR § 354.28(c)(1)
[92] Groundwater Management Plan, Section 5.4.2, p. 5-6
[93] 23 CCR § 354.28(c)(2)

The Plan describes end-of-year storage targets of 278,000 and 5,000 acre-feet for the Santa Clara Plain and Coyote Valley areas, respectively.[94] The District's Functional Equivalency Report cites the sections of the Plan describing the storage targets as being equivalent to the minimum thresholds required in a GSP.[95] The storage targets were derived from the District's 2015 Urban Water Management Plan, which identified a combined storage target of 300,000 acre-feet for the Santa Clara and Llagas subbasins as the bottom of the "normal" range where no contingency actions are needed.[96] The Urban Water Management Plan provides additional details of the storage analysis and describes subsequent contingency actions to be taken if the end-of-year storage targets are not met.[97] The 2015 Annual Groundwater Report describes that the end-of-year storage volumes were not met in 2015 (a drought year), when a total of approximately 215,000 acre-feet of groundwater was in storage.[98] This condition triggered a countywide water use reduction of 30 percent in 2015, which was reduced to a 20 percent reduction in 2016; the water use reduction triggers were described as being consistent with District's Water Shortage Contingency Plan.[99]

c. Seawater Intrusion

GSP Regulations specify that the minimum threshold for seawater intrusion be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.[100]

The Plan provides chloride isoconcentration contours to support its description of historical seawater intrusion in the shallow aquifer (*see* Groundwater Conditions, above). A specific contour depicting an operational threshold was not used for the District's groundwater management planning. The District also includes chloride in its water quality outcome measure (*see* Degraded Water Quality, below) for the stated purpose of evaluating potential seawater intrusion.[101]

d. Degraded Water Quality

GSP Regulations specify that the minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair

[94] Groundwater Management Plan, Section 5.4.1, p. 5-6
[95] Groundwater Management Plan, Appendix B, p. B-13
[96] Groundwater Management Plan, Section 5.4.1, p. 5-6
[97] 2015 Urban Water Management Plan, Table 8-1, p. 8-3
[98] 2015 Annual Groundwater Report, Section 3.2, p. 24
[99] 2015 Annual Groundwater Report, Section 3.2, p. 19
[100] 23 CCR § 354.28(c)(3)
[101] Groundwater Management Plan, Section 5.4.3, p. 5-8

water supplies or other indicator of water quality as determined by the agency that may lead to undesirable results.[102]

The Plan describes two water quality outcome measures for the Plan area, which covers both the Santa Clara Subbasin and the adjacent Llagas Subbasin. The first outcome measure is that at least 95 percent of countywide water supply wells meet primary drinking water standards and 90 percent of wells in the "South County" area (comprised of the Coyote Valley management area of the Santa Clara Subbasin and the adjacent Llagas Subbasin) meet agricultural objectives defined in the Regional Water Quality Control Board's Basin Plan.[103]The Plan describes that this outcome measure is primarily related to groundwater that is used (i.e., extracted) and, because most groundwater is extracted from the principal aquifer zone, only wells in that zone are tracked for this measure.[104] The 2015 Annual Report describes that the drinking water component of this outcome measure was not met in 2015, when 84 percent of wells county-wide met primary drinking water standards.[105] The 2015 Annual Report explained that all of the instances where drinking water standards were not met were due to nitrate detections in domestic wells located in the "South County" area. The agricultural water quality component of the outcome measure was met in 2015, with 98 percent of wells meeting agricultural water quality objectives.

The second outcome measure is that at least 90 percent of wells in both the shallow and principal aquifer zones have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.[106] The 2015 Annual Report describes that the nitrate and total dissolved solids components of this outcome measure were met in 2015, but that it was not met for chloride, when 84 percent of wells showed stable or decreasing chloride concentrations.

e. Land Subsidence

GSP Regulations specify that the minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results.[107]

The Plan states the District defined groundwater-level thresholds for land subsidence in 1991 and identifies maintenance of groundwater levels above the thresholds, which are identified at 10 monitoring sites, as an outcome measure for the Subbasin.[108] The Plan

[102] 23 CCR § 354.28(c)(4)
[103] Groundwater Management Plan, Section 5.4.3, p. 5-7
[104] Groundwater Management Plan, Section 5.4.3, p, 5-7
[105] 2015 Annual Groundwater Report, Section 5, p. 34
[106] Groundwater Management Plan, Section 5.4.3, p. 5-8
[107] 23 CCR § 354.28(c)(5)
[108] Groundwater Management Plan, Table 5-1, p. 5-7

notes that exceedance of those groundwater-level thresholds may represent conditions under which subsidence could exceed the 0.01 foot per year rate that was agreed to in 1991 as a maximum acceptable rate of subsidence.[109]

f. Depletion of Interconnected Surface Water

GSP Regulations specify that the minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.[110]

The District identifies interconnected surface water as only occurring in discrete areas on the margins of the Subbasin which are associated with recharge and discharge zones and largely appear to be controlled by the underlying geologic conditions.[111] The Plan states surface water flows are an integral part of the District's groundwater management, as creeks and streams are largely utilized for the purpose of controlled, deliberate groundwater recharge and the District relies on losing stream reaches to achieve this purpose.[112] As such, sustainable management criteria have not been established to avoid significant and unreasonable depletion of interconnected surface water.[113]

D. Monitoring Networks

GSP Regulations require that each basin be monitored, and that a monitoring network include monitoring objectives, monitoring protocols, and data reporting requirements be developed that shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions.[114]

The Plan describes the groundwater level, subsidence, water quality, and surface water (flow and quality) monitoring programs in place to measure progress or maintenance of the District's outcome measures and sustainability goals.

Groundwater level monitoring includes a network of 158 wells monitored directly by the District, and in addition to these, over 100 production wells monitored by water retailers in the Subbasin.[115] The wells are distributed throughout the basin to describe various pumping and recharge locations such that detailed mapping of the potentiometric surface can be performed. The District provides detailed descriptions of the monitoring well

[109] Groundwater Management Plan, Section 5.4.2, p. 5-6
[110] 23 CCR § 354.28(c)(6)
[111] Groundwater Management Plan, Section 2.2.3, p. 2-14
[112] Groundwater Management Plan, Section 2.2.3, p. 2-14
[113] Groundwater Management Plan, Section 2.2.3, p. 2-14
[114] 23 CCR § 354.32
[115] Groundwater Management Plan, Section 7.1.1, p. 7-1

network including construction details, well type, monitoring frequency, and other details.[116] The District provides a description of the range of monitoring frequency for these wells based upon management needs and include frequencies of daily, weekly/biweekly, monthly, bimonthly, and quarterly. The 158 District monitoring wells are all monitored at least monthly to provide the agency timely information to support management actions.[117] The Groundwater Management Plan provides a description of accuracy of well head reference elevation and potential error associated with the variety of methods used.[118]

Subsidence monitoring is an essential element and driving condition for management of the groundwater resources in the Subbasin. As such the District describes a monitoring network that includes annual surveys of over 150 benchmarks, use of two continuously monitoring extensometers, and a network of 10 subsidence index wells monitoring groundwater levels.[119] The subsidence index wells serve as an early warning effort to monitor if groundwater levels are above minimum thresholds on at least a monthly basis. The monitoring results are confirmed by use of the additional extensometer measurements and benchmark surveys to evaluate progress toward the District's outcome measures and sustainability goals.

The District maintains a water quality monitoring network of 55 wells in the Subbasin (30 in the shallow aquifer zone and 25 in the principal aquifer zone) that are sampled annually for trace elements, ions, nutrients, and field parameters (e.g., pH, specific conductance, and temperature), and every three years for volatile organic compounds.[120] In addition, results from annual Division of Drinking Water quality compliance testing are included for approximately 225 production wells from the Santa Clara and Llagas subbasins.[121] The District also collects water quality samples from more than 200 domestic wells in the Santa Clara and Llagas subbasins and near recycled water irrigation sites. The District also incorporates, on an as-needed basis, water quality information from other agencies and programs including, the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program and the Irrigated Lands Regulatory Program.[122]

Surface water monitoring described by the District includes the evaluation of water quality and discharge of surface waters within the Subbasin to properly manage recharge efforts. The District identifies the sampling locations for water quality and discharge locations throughout the Subbasin. Water quality samples are collected at seven stream recharge

[116] Groundwater Management Plan, Appendix E, p. E-3
[117] Groundwater Management Plan, Section 7.1.1, p. 7-1
[118] Groundwater Management Plan, Section 7.1.2.1, p. 7-3
[119] Groundwater Management Plan, Section 7.2, p. 7-6
[120] Groundwater Management Plan, Section 7.3, p. 7-9
[121] Groundwater Management Plan, Section 7.3.2, p. 7-13
[122] Groundwater Management Plan, Section 7.3.5, p. 7-19

system sites on a triennial rotating basis during both dry and wet seasonal conditions with 90 samples being collected in total over the three-year period.[123] In addition to collecting surface water quality and discharge data, the District coordinates and incorporates data from other agencies and programs including: the Santa Clara Valley Urban Runoff Pollution Prevention Program and the Central Coast Regional Water Quality Control Board's Central Coast Ambient Monitoring Program.

Data collected as part of the District's monitoring programs are stored in databases and are largely available on the District's websites. The monitoring data is incorporated into various reporting structures that regularly inform management actions by the District, these include: Water Tracker (monthly), Monthly Groundwater Condition Report, Protection and Augmentation of Water Supplies Report (annual), and the Annual Groundwater Report.[124] These data and reports support ongoing modelling efforts to support the District's forecasting ability and ongoing evaluation of conditions in the Subbasin.

E. Projects and Management Actions.

GSP Regulations require a description of the projects and management actions the submitting agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.[125]

The Groundwater Management Plan provides a portfolio of projects and management actions that are currently being implemented by the District or other agencies to address the sustainability goals of optimizing groundwater reliability and the protection of groundwater quality. The District also explains that the District Act provides the authority to advance additional projects on an as-needed basis and advancement of significant projects through the capital improvement program. The Plan organizes these projects and management actions into three primary categories; projects supporting groundwater reliability, groundwater quality, and surface water - groundwater interactions.

Programs to maintain reliable groundwater supply include managed aquifer recharge, in-lieu recharge, protection of natural recharge, groundwater production management, water accounting, groundwater level and storage assessments, and asset management.[126] Programs to protect groundwater quality include a well ordinance program, domestic well testing program, salt and nutrient management, nitrate treatment system rebate program, vulnerability assessment studies, coordination with land use agencies, coordination with

[123] Groundwater Management Plan, Section 7.4, p. 7-23
[124] Groundwater Management Plan, Section 7.5, p. 7-28
[125] 23 CCR § 354.44
[126] Groundwater Management Plan Section 6.1, p. 6-1

regulatory agencies, and public outreach.[127] Programs related to surface water - groundwater interaction provide ongoing integrated management of these resources serve to address both reliability and quality needs of the beneficial uses and users in the Subbasin and include the managed in-stream releases of surface water, stormwater management, prevention of salt water intrusion, and watershed management.[128]

VI. Assessment

The following describes the evaluation and assessment of the Alternative for the Santa Clara Subbasin as determined by Department staff. In undertaking this assessment, Department staff did not conduct geologic or engineering studies, although Department staff may have relied on publicly available geologic or engineering or other technical information to verify claims or assumptions presented in the Alternative.[129] As discussed above, Department staff have determined that the Santa Clara Alternative satisfied the conditions for submission of an alternative.[130] The Alternative was submitted within the statutory period, the Subbasin was found to be in compliance with the reporting requirements of CASGEM, and staff find the Alternative to be complete and to cover the entire basin (*see* Required Conditions, above). Based on its evaluation and assessment of the Santa Clara Alternative, as discussed below, Department staff find that the Alternative satisfies the objectives of SGMA.[131]

A. Evaluation of Alternative Contents

The District describes in sufficient detail its authority to manage groundwater within its statutory boundaries, which encompasses the Santa Clara Subbasin. The Groundwater Management Plan and the District Act document the legal authority and describe past and planned future authority to implement and finance necessary projects. The District describes the evolution of the District dating back to 1929 with the Santa Clara Valley Water Conservation District charged with the initial mission of stopping groundwater overdraft and subsidence. Since that time the District has grown through consolidation and annexation of other flood control and water districts. The District has demonstrated implementation of numerous projects and management actions to address the primary drivers of flood control, water reliability, and water quality conditions in the Subbasin. The District has funded and cooperated with numerous studies to characterize groundwater conditions in the County for a variety of factors to inform management strategies. That history of management in the Subbasin provides a reasonable level of confidence that

[127] Groundwater Management Plan, Section 6.2, p. 6-9
[128] Groundwater Management Plan, Section 6.3, p. 6-18
[129] Instances where the Department review relied upon publicly available data that was not part of the Alternative are specifically noted in the assessment.
[130] 23 CCR § 358.4(a)
[131] Water Code § 10733.6(a); 23 CCR § 358.4(b)

the District can continue implementation of the Groundwater Management Plan to meet its sustainability goals.

The Groundwater Management Plan and associated technical studies and plans demonstrate a sufficient understanding of the basin setting, including the geology and groundwater conditions of the Santa Clara Subbasin. The Plan and supporting technical studies, including the 2015 Annual Report, 2015 Urban Water Management Plan, and the Salt and Nutrient Management Plan appear to rely on best available information and best available science and their conclusions are consistent with the Department's understanding of conditions in the Santa Clara Subbasin. The hydrogeologic conceptual model described in the Plan incorporates the relevant hydrologic processes in the entire basin to support analysis presented. The use of numerical models in the Subbasin to support operational and long-term planning decisions also provide support for water budget estimates. The District's numerical models are used to provide on-going estimates of groundwater storage to support management actions of required replenishment activities. The District's understanding of the basin setting is adequate to develop and implement a plan for sustainable groundwater management. However, Department staff recommend that the District address identification of groundwater dependent ecosystems (*see* Recommended Action 1) and incorporation of climate change into its projected water budget (*see* Recommended Action 2).

The Plan identifies sustainability goals for the County and specific, quantitative outcome measures for groundwater storage and land subsidence in the Santa Clara Subbasin and for water quality in the combined Santa Clara and Llagas subbasins. The District's storage outcome measure is an end-of-year storage target of 278,000 and 5,000 acre-feet for the Santa Clara Plain and Coyote Valley areas, respectively. The District has identified specific actions that occur if that storage target is not met, as defined in the 2015 Urban Water Management Plan. Land subsidence outcome measures are based on maintaining groundwater elevations above identified thresholds at a set of index wells. Except for minor exceedances at one of the ten subsidence index wells during the most recent drought, water levels have remained above these thresholds since approximately the mid-1990s. Water quality outcome measures utilize primary drinking water standards and Central Coast Regional Water Quality Control Board Basin Plan agricultural water quality standards. The water quality outcome measure address both the number of detections above the identified thresholds and trends of key constituents identified for the County. Department staff recommend that the water quality outcome measures, which in the Plan are defined County-wide (i.e., they are set based on water quality in both the Santa Clara and Llagas subbasins), be refined in future updates to the Alternative with separate quantitative measures specific to the respective subbasins (*see* Recommended Action 3). The District already reports water quality detections and trends separately by subbasin but, as presently configured in the Plan, it is not possible to determine whether failure to

achieve the outcome measures represents an undesirable result for both subbasins or whether the undesirable result is applicable to a specific subbasin.[132] In separating the water quality outcome measures by subbasin and in light of the described anticipated sea level rise, Department staff also recommend identifying specific water quality measures to track for potential seawater intrusion in the Santa Clara Plain area (*see* Recommended Action 4).

Additionally, the outcome measures defined by the District are the only quantitative standards outlined in the Plan and, as indicated in the 2015 Annual Groundwater Report, several of those standards were not met in 2015 (e.g., for end-of-year storage). While alternatives are not required to follow the exact format of a GSP, the GSP Regulations do outline a process for GSP development that includes quantitative standards both for measurable objectives, which represent conditions that the basin is operated toward; and minimum thresholds, which represent conditions that generally are to be avoided so as to not cause undesirable results. It was not clear to Department staff whether those outcome measures were generally more equivalent to measurable objectives or minimum thresholds but, in the absence of any other quantifiable standard, the Department's ongoing review of whether the Alternative satisfies the objectives of SGMA will focus on whether the District is able to meet those outcomes to avoid undesirable results in the Subbasin. If the outcome measures are more equivalent to measurable objectives and there is another metric that is generally more representative of conditions that the District intends to avoid in the Subbasin to prevent undesirable results, then the District should provide those metrics in an update to the Alternative (*see* Recommended Action 5).

The District describes specific monitoring networks that address groundwater levels, groundwater quality, subsidence conditions, surface water quality, and surface water flows. The data collected from these locations typically represent long periods of observations and data collection. Based upon the description of the hydrogeologic system, the distribution of dedicated monitoring wells, subsidence monitoring locations, and use of existing water supply wells appears to be reasonable. The data provide an adequate and reasonable distribution of direct observations of conditions within the Subbasin to allow for informed decisions and planning for sustainable groundwater management. The frequency of data collected from the monitoring networks is adequate to characterize the seasonal variability and management-action based variability of the groundwater and related systems.

Management actions and projects described in the Plan are consistent with the requirements of SGMA and the GSP Regulations. The management actions and projects the District has implemented and is planning on implementing provide for continued progress toward meeting the sustainability goal for the Subbasin. The projects and

[132] 2015 Annual Groundwater Report, Table 8, p. 37

management actions the District has developed have led to meeting or making significant progress to their specific measurable objectives for storage, land subsidence, and water quality. The groundwater conditions described in the Plan illustrate the maintenance of the targeted conditions described in the measurable objectives, with exception of drought periods where additional prescribed actions were implemented, such as water conservation and calls on banked water options. In addition, recovery following drought or dry periods was accomplished in accordance to the Plan and typically occurred within the next water year. Continued implementation of planned projects, programs, and coordinated effort on water quality objectives will likely result in continued progress toward this objective. Discussions of funding for projects appears to be reasonable. The District describes a clear process previously implemented to apply an adaptive management strategy for development, funding, and implementation of necessary projects to support the sustainability goals.

The Groundwater Management Plan for the Santa Clara Subbasin is specifically designed to manage groundwater supplies to optimize water supply reliability and to protect the basin against undesirable results including overdraft, subsidence, seawater intrusion, and other sources of groundwater contamination, and so appears consistent with Water Code Section 106.3, which establishes the state policy that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.” Department staff consider that the Groundwater Management Plan, which utilizes natural waterways in the basin to recharge the aquifers, appears also to be consistent with the public trust doctrine.

B. Recommended Actions

The following recommended actions include information that the District may wish to include in the first five-year update of the Alternative to facilitate the Department’s ongoing evaluation and assessment of the Alternative as well as recommendations for improvements to the Alternative.

Recommended Action 1.

Staff recommend that the District provide an identification of groundwater dependent ecosystems in the Subbasin.

Recommended Action 2.

Staff recommend that the District provide a projected water budget incorporating climate change and expected population growth over the planning and implementation horizon of 50 years.

Recommended Action 3.

Staff recommend that the District create separate outcome measures related to water quality in the Santa Clara and Llagas subbasins. Separate subbasin-specific criteria will allow for a determination of whether each subbasin, separately, is meeting or making progress toward the outcome measures.

Recommended Action 4.

Staff recommend the District develop specific seawater intrusion outcome measures separate from other water quality outcome measures.

Recommended Action 5.

Staff recommend that the District clarify how meeting its outcome measures relates to the avoidance of undesirable results in the Santa Clara Subbasin. Specifically, it should clarify whether not meeting the outcome measures represents an undesirable result for the applicable sustainability indicator. If that is not the intent of the District, then it should provide additional clarification and additional metrics that can be used by the District, and by the Department as it reviews the Alternative on an ongoing basis, to determine what effects represent undesirable results and to objectively assess the presence or absence of those undesirable results.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE
901 P Street, Room 313-B | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

July 17, 2019

Ms. Vanessa De La Piedra
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, California 95118

Dear Ms. De La Piedra,

The Department of Water Resources (Department) has evaluated the alternative submitted for the Llagas Subbasin. Based on recommendations from the Staff Report, included as an exhibit to the attached Statement of Findings, the Department has determined that the Llagas Alternative satisfies the objectives of the Sustainable Groundwater Management Act (SGMA) and is approved. The Staff Report also proposes recommended actions for the consideration of the Santa Clara Valley Water District that the Department believes will enhance the Alternative and facilitate future evaluation by the Department. The recommended actions do not constitute a qualified approval of the Alternative; however, the Department encourages they be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates.

As required by SGMA, the Department shall review approved alternatives to ensure they remain in compliance with the objectives of the Act. Approved alternatives are required to submit annual reports to the Department on April 1 of each year, and to resubmit the alternative by January 1 every five years. The first five-year update is due by January 1, 2022.

Please contact me at (916) 651-0870 or Craig.Altare@water.ca.gov if you have any questions related to the Department's evaluation or your implementation of the approved alternative.

Thank You,

Craig Altare, P.G.
Supervising Engineering Geologist

Attachments:
1. Statement of Findings Regarding the Approval of the Llagas Subbasin Alternative

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Alternative Assessment Staff Report

Groundwater Basin Name: Gilroy-Hollister Valley – Llagas (Basin No. 3-003.01)
Submitting Agency: Santa Clara Valley Water District
Recommendation: Approve
Date Issued: July 17, 2019

I. Summary

The Santa Clara Valley Water District (District) submitted an alternative (Llagas Alternative or Alternative) to the Department of Water Resources (Department) for evaluation and assessment as provided by the Sustainable Groundwater Management Act (SGMA).[1] The District submitted an existing plan, which relies primarily on the 2016 Groundwater Management Plan (Groundwater Management Plan or Plan).[2]

The District was formed in 1929, following enactment of the first voter-approved groundwater protection law in Santa Clara County. The law charged the District with the responsibility of stopping groundwater overdraft and subsidence in accordance with the Santa Clara Valley Water District Act (District Act).[3] The District manages water resources for the entire County, which includes two groundwater subbasins, the Santa Clara Subbasin of the Santa Clara Valley Groundwater Basin and the Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin (Llagas Subbasin or Subbasin). While the District Act was primarily a result of adverse conditions in the Santa Clara Subbasin, it provided direction for the District to manage water resources County wide and, therefore, the Groundwater Management Plan includes both subbasins.[4]

The Alternative demonstrates a long history of implementing the requirements of the District Act. The District has done this by developing a good understanding of the hydrogeologic conditions of the Subbasin, establishing significant water imports, and

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[1] Water Code § 10720 *et seq*.
[2] Water Code § 10733.6(b)(1)
[3] Water Code, App. § 60-1 *et seq*. (Stats.1951, c. 1405, p. 3337)
[4] The District submitted the 2016 Groundwater Management Plan as an Alternative for both the Santa Clara and Llagas subbasins. This assessment is specifically related to the Department's review for the Llagas Subbasin.

managing those resources to meet the demands of the beneficial uses and users. The District has conducted numerous studies to identify appropriate actions to capture surface water runoff and store it for the purposes of replenishment of the groundwater. The quantification of required volumes, timing, and distribution of recharge have resulted in management of the Subbasin that has avoided overdraft and subsidence. The District's Groundwater Management Plan has established objectives to maintain the avoidance of adverse groundwater conditions in the Subbasin and documents specific plans and management actions to achieve those objectives. These plans and management actions are based on proven technologies, are reasonable and feasible, and present solutions to meet the objectives of the District Act.

Based on review of the Plan, other related documents, and consideration of public comments, Department staff believe the Llagas Alternative satisfies the objectives of SGMA for the Llagas Subbasin and recommends approval of the alternative. Staff consider the information provided by the District to be sufficient and credible, and that implementation of the Groundwater Management Plan is reasonably likely to lead to sustainable groundwater management of the Subbasin.[5] In addition, staff have identified recommended actions that are designed to facilitate the Department's ongoing evaluation and assessment of the Plan including implementation and a determination of whether the Plan continues to satisfy the objectives of SGMA or adversely affects an adjacent basin.

The remainder of this assessment is organized as follows:

- **Section II. Review Principles** describes legal and other considerations regarding the Department's assessment and evaluation of alternatives.
- **Section III. Alternative Materials** describes materials (i.e., plans, reports, data, and other information) submitted by the Agency that, collectively, the Department staff considered as the Alternative.
- **Section IV. Required Conditions** describes whether the Alternative satisfies each of the four conditions required for the Department to review an alternative.
- **Section V. Alternative Contents** describes the information contained in the Alternative submittal.
- **Section VI. Assessment** describes Department staff's evaluation of the Alternative, whether it satisfies the objectives of SGMA, and, if applicable, describes recommended actions proposed for the first five-year update.

[5] Water Code § 10721(v). See also discussion in Section II. Review Principles. Sustainable groundwater management is achieved by meeting the basin's sustainability goal.

II. Review Principles

The District submitted an alternative based on a groundwater management plan to the Department for evaluation and assessment to determine whether it satisfies the objectives of SGMA for the Llagas Subbasin. To satisfy the objectives of SGMA, an alternative based on a groundwater management plan prepared pursuant to Part 2.75 of Division 6 of the Water Code[6] or a plan developed pursuant to another law authorizing groundwater management must demonstrate that implementation of the plan has led to or will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[7] Undesirable results are defined quantitatively by the managing agency.[8]

An alternative, to be evaluated by the Department, must be submitted by the statutory deadline and be within a basin that complies with Part 2.11 of Division 6 of the Water Code.[9] The submitted alternative must also be complete and must cover the entire basin.[10] The Groundwater Sustainability Plan (GSP) Regulations[11] require the Department to evaluate an Alternative "in accordance with Sections 355.2, 355.4(b), and Section 355.6, *as applicable*, to determine whether the Alternative complies with the objectives of the Act".[12] The elements of the cited sections are not all applicable to alternatives. Some provisions apply to GSPs and alternatives alike, to alternatives only prospectively, or do not apply to alternatives at all.[13] Ultimately, the purpose of the evaluation is to determine whether an alternative satisfies the objectives of SGMA.[14] The agency must explain how the elements of an alternative are "functionally equivalent" to

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[6] Water Code § 10750 *et seq.*
[7] Water Code 10721(v)
[8] 23 CCR § 354.26
[9] Water Code § 10733.6(c)-(d)
[10] 23 CCR § 358.4(a)
[11] 23 CCR § 350 *et seq.*
[12] 23 CCR § 358.4(b) (emphasis added)
[13] Procedural requirements, including submissions by the agency, posting by the Department, and the public comment period, apply equally to plans and alternatives (23 CCR § 355.2(a)-(c)). The periodic review of Plans (23 CCR § 355.6(a)) applies to alternatives prospectively but does not apply to initial submissions. Other regulatory provisions are inapplicable to alternatives, including the two-year review period (23 CCR § 355.2(e)), which is based on the statutory time-frame that applies to Plans but not alternatives (Water Code § 10733.4(d)); the "incomplete" status that allows the agency to address "one or more deficiencies that preclude approval, but which may be capable of being corrected by the Agency in a timely manner" (23 CCR § 355.2(e)(2)), which applies to plans undergoing development, but not alternatives that purportedly satisfy the objectives of SGMA at the time of their submission (Water Code § 10733.6(a)); and, for the same reason, corrective actions to address deficiencies in plans (23 CCR § 355.4(a)(4)), which applies to plans developed after the adoption of SGMA, but is inapplicable to alternatives that predate SGMA.
[14] 23 CCR § 358.2(d), based on the statutory threshold of "whether the alternative satisfies the objectives of [SGMA] for the basin" (Water Code § 10733.6(a)).

the elements of a GSP required by Articles 5 and 7 of the GSP Regulations and are sufficient to demonstrate the ability of an alternative to achieve the objectives of SGMA.[15] The explanation by the agency that elements of an alternative are functionally equivalent to elements of a GSP furthers the objective of demonstrating that an alternative satisfies the objectives of SGMA. Alternatives based on groundwater management plans or historical basin management practices that predate the passage of SGMA or adoption of GSP Regulations, although required to satisfy the objectives of SGMA, are not necessarily expected to conform to the precise format and content of a GSP. The Department's assessment is thus focused on the ability of an alternative to satisfy the objectives of SGMA as demonstrated by information provided by the agency; it is not a determination of the degree to which an alternative matched the specific requirements of the GSP Regulations.

When evaluating whether an alternative satisfies the objectives of SGMA and thus is likely to achieve the sustainability goal for the basin, staff review the information provided by and relied upon by the agency for sufficiency, credibility, and consistency with scientific and engineering professional standards of practice.[16] The Department's review considers whether there is a reasonable relationship between the information provided and the assumptions and conclusions made by the agency, whether sustainable management criteria and projects and management actions described in an alternative are commensurate with the level of understanding of the basin setting, and whether those projects and management actions are feasible and likely to prevent undesirable results.[17] Staff will recommend that an alternative be approved if staff believe, in light of these factors, that alternative has achieved or is likely to achieve the sustainability goal for the basin.[18]

An alternative that relies on an existing plan may be approved based on information that demonstrates the basin is being or will be managed sustainably based on groundwater management pursuant to that plan, including any related projects and management actions, as necessary. Even when staff review indicates that an alternative will satisfy the objective of SGMA, the Department may recommend actions to facilitate future evaluation of that alternative and to allow the Department to better evaluate whether an alternative adversely affects adjacent basins. DWR proposes that recommended actions be addressed by the submission date for the first periodic evaluation.

Staff assessment of an alternative involves the review of information presented by the agency, including models and assumptions, and an evaluation of that information based

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[15] 23 CCR § 358.2(d)
[16] 23 CCR § 351(h)
[17] 23 CCR § 355.4(b)(1), (3), and (5).
[18] 23 CCR § 355.4(b)

on scientific reasonableness. The assessment does not require Department staff to recalculate or reevaluate technical information provided in an alternative or to perform its own geologic or engineering analysis of that information. The staff recommendation to approve an alternative does not signify that Department staff, were they to exercise the professional judgment required to develop a plan for the basin, would make the same assumptions and interpretations as those contained in an alternative, but simply that Department staff have determined that the assumptions and interpretations relied upon by the submitting agency are supported by adequate, credible evidence, and are scientifically reasonable.

III. Alternative Materials

The District submitted an alternative based on a groundwater management plan pursuant to Water Code Section 10733.6(b)(1). The Alternative thus relies primarily upon the following document:

- Santa Clara Valley Water District 2016 Groundwater Management Plan, November 2016 (Groundwater Management Plan *or* Plan).

The District submitted the following additional plans, reports, and other documents prepared prior to the implementation of SGMA that the Department has determined to be sufficiently related to the Groundwater Management Plan to warrant their consideration as part of the Alternative:

- Santa Clara Valley Water District, 2016, Annual Groundwater Report for Calendar Year 2015 (2015 Annual Report).
- Santa Clara Valley Water District, December 2014, Final Salt and Nutrient Management Plan – Llagas Subbasin (Salt and Nutrient Management Plan).
- Santa Clara Valley Water District, 2016, 2015 Urban Water Management Plan (2015 Urban Water Management Plan).
- Santa Clara Valley Water District, Online – Historical Groundwater Elevation Data, https://gis.valleywater.org/groundwaterelevations/map.php.
- Santa Clara Valley Water District Act (District Act), https://www.valleywater.org/how-we-operate/about-the-water-district/district-act.

The District submitted a Groundwater Management Plan Appendix B - Demonstration of Functional Equivalency of the Alternative to address the required Alternative Elements Guide. The District has also submitted Annual Reports.[19] Other material submitted by the District, public comments, other documents submitted by third parties, correspondence,

[19] The Annual Report is not part of the Alternative and was not reviewed by the Department for the purpose of approving the Alternative.

and other information provided to or relied upon by the Department have been posted on the Department's web site.

IV. Required Conditions

An alternative, to be evaluated by the Department, must be submitted by the statutory deadline and be within a basin that complies with Part 2.11 of Division 6 of the Water Code.[20] The submitted alternative must also be complete and must cover the entire basin.[21]

A. Submission Deadline

SGMA requires that an alternative for a Basin categorized as high- or medium-priority as of January 31, 2015, be submitted no later than January 1, 2017.[22]

The Santa Clara Valley Water District submitted its Alternative on December 21, 2016, before the statutory deadline.

B. Part 2.11 (CASGEM) Compliance

SGMA requires that the Department assess whether an alternative is within a basin that is in compliance with Part 2.11 of Division 6 of the Water Code,[23] which requires that groundwater elevations in all groundwater basins be regularly and systematically monitored and that groundwater elevation reports be submitted to the Department.[24] To manage its obligations under this law, the Department established the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. The acronym CASGEM is used in this document to denote both the program and the groundwater monitoring law.[25]

SGMA specifies that an alternative does not satisfy the objectives of SGMA if the Basin is not in compliance with the requirements of CASGEM.[26] The Department confirmed that the Llagas Subbasin was in compliance with the requirements of CASGEM prior to evaluating the Alternative and confirmed that the Subbasin remained in compliance with CASGEM through the last reporting deadline prior to issuing this assessment.

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[20] Water Code § 10733.6(c)-(d)
[21] 23 CCR § 358.4(a)
[22] Water Code § 10733.6(c). Pursuant to Water Code § 10722.4(d), a different deadline applies to a Basin that has been elevated from low- or very low-priority to high- or medium-priority after January 31, 2015.
[23] Water Code § 10733.6(d)
[24] Water Code § 10920 *et seq*.
[25] Stats.2009-2010, 7th Ex.Sess., c. 1 (S.B.6), § 1
[26] Water Code § 10733.6(d)

C. Completeness

GSP Regulations specify that the Department shall evaluate an alternative if that alternative is complete and includes the information required by SGMA and the GSP Regulations.[27] An alternative submitted pursuant to Water Code Section 10733.6(b)(1) must include a copy of the groundwater management plan and an explanation of how the elements of the Alternative are functionally equivalent to the elements of a Plan required by Articles 5 and 7 of the GSP Regulations and are sufficient to demonstrate the ability of the Alternative to achieve the objectives of SGMA.[28]

The District submitted a completed and final 2016 Groundwater Management Plan for the Llagas Subbasin, complementary documents, as indicated above, and other materials as required. Department staff found the Alternative to be complete and containing the required information, sufficient to warrant an evaluation by the Department.

D. Basin Coverage

An alternative must cover the entire basin.[29] An alternative that is intended to cover the entire basin may be presumed to do so if the basin is fully contained within the jurisdictional boundaries of the submitting agency.

The jurisdictional boundaries of the Santa Clara Valley Water District cover the entire Llagas Subbasin.[30] The Districts' authority aligns with Santa Clara County's jurisdictional boundaries and wholly cover the Llagas Subbasin.

V. Alternative Contents

GSP Regulations require the submitting agency to explain how the elements of an alternative are functionally equivalent to the elements of a GSP as required by Article 5 of the GSP regulations[31] and are sufficient to demonstrate the ability of an alternative to achieve the objectives of SGMA.[32]

As stated previously, alternatives based on historical basin management practices that predate the passage of SGMA or adoption of GSP Regulations, although required to satisfy the objectives of SGMA, are not necessarily expected to conform to the precise

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[27] 23 CCR § 358.4(a)(3)
[28] 23 CCR § 358.2(c)-(d)
[29] 23 CCR § 358.4(a)(4)
[30] SGMA Alternative Portal, Attachment B-3 (https://sgma.water.ca.gov/portal/alternative/print/20)
[31] 23 CCR § 354-354.44
[32] 23 CCR § 358.2(d). The requirements pertaining to Article 7 of the GSP Regulations (23 CCR § 356-356.4) relate to annual reports and periodic evaluation and are not applicable to review of the initial alternative.

format and content of a GSP, and the criteria for adequacy of an alternative is whether the Department is able to determine that an alternative satisfies the objectives of SGMA. Department staff rely on the submitting agency's determination of functional equivalence of alternative elements to facilitate its evaluation and assessment of an alternative (*see* Assessment, below). Although the exact components of a GSP are not required for an alternative, for organizational purposes the discussion of information contained in the Groundwater Management Plan and related documents provided by the District generally follows the elements of a GSP provided in Article 5 of the GSP Regulations. The reference to requirements of the GSP Regulations at the beginning of each section is to provide context regarding the nature of the element discussed but is not meant to define a strict standard applicable to alternatives.

A. Administrative Information

GSP Regulations require information identifying the submitting agency, describing the plan area, and demonstrating the legal authority and ability of the submitting agency to develop and implement a plan for that area.[33]

The Groundwater Management Plan contains information describing the history, governance structure, and financial capabilities for the Santa Clara Valley Water District.[34] The Plan describes the structure that the District, a water wholesaler, uses to engage with the various water retailers; land use agencies; local, state, and federal agencies; and other stakeholders. A discussion and supporting documentation of the specific public outreach that was conducted as part of the Plan development is provided.[35]

The District Act, established in 1929 to address the primary objectives of overdraft and subsidence, provides the District with the statutory authority to manage groundwater in the county, identifies the consideration of all beneficial uses and users, and defines the primary objectives for the Subbasin.[36] The description of the administration and groundwater management associated with the District Act implementation includes an overview of decades of engagement by a public agency responsible for managing the groundwater and surface water resources of the Subbasin. The District determined that, to meet water demand in the Subbasin and avoid adverse conditions, additional supply was necessary and developed agreements to receive surface waters from the San Francisco Public Utility Commission and the Central Valley Project through a series of projects to store and distribute these waters.[37] The Plan also describes the District's

[33] 23 CCR § 354.2 et seq.
[34] Groundwater Management Plan, Section 1-4, pp. 1-3
[35] Groundwater Management Plan, Appendix A
[36] District Act, Section 5(5)
[37] Groundwater Management Plan, Section 1.4.1, p. 1-8

ability to adapt to changing demands and conditions in the Subbasin, such as the evolution of land use from agricultural to urban and industrial, with concomitant changes to water quality protection efforts including hazardous materials storage permit requirements.[38] Other examples include conservation programs, recycled water programs, and cooperative engagement with the Regional Water Quality control boards to address point source contaminants from leaky underground storage tank sites and other significant industrial contaminant release sites.[39]

B. Basin Setting

GSP Regulations require information about the physical setting and characteristics of the basin and current conditions of the basin, including a hydrogeologic conceptual model, a description of historical and current groundwater conditions, and an assessment of the water budget.[40]

1. Hydrogeologic Conceptual Model

The GSP Regulations require a descriptive hydrogeologic conceptual model of the basin that includes a written description supported by cross sections and maps.[41]

The Groundwater Management Plan includes a hydrogeologic conceptual model that describes the lateral and vertical extents of the Basin, recharge areas, principal aquifers and aquitards, and significant faults within the Basin.[42] The Plan describes the Subbasin as unconsolidated alluvial material with two main aquifers generally dipping to the southeast toward the Pajaro River. The Plan identifies “shallow aquifer zones” as those aquifer zones less than 150 below ground surface and “principal aquifer zones” as aquifer zones occurring generally at depths greater than 150 feet below ground surface.[43] The northwestern and margins of the Subbasin are largely unconfined and serve as recharge areas, while in the central and southeastern portions of the Subbasin the principal aquifer zone is confined and the shallow aquifer zone is unconfined.[44] The Subbasin ranges in thickness from a few feet on the eastern and western margins to about 500 feet in the middle of the northwestern end of the Subbasin and over 1,000 feet thick in the central southeastern end of the Subbasin.[45]

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[38] Groundwater Management Plan, Section 1.4.1, p. 1-9
[39] Groundwater Management Plan, Section 1.4.1, p. 1-9
[40] 23 CCR § 354.*12 et seq.*
[41] 23 CCR § 354.14(a)
[42] Groundwater Management Plan, Section 3.1, pp. 3-1 to 3-7
[43] Groundwater Management Plan, Section 3.1.3, p. 3-2
[44] Groundwater Management Plan, Figure 3-3, p. 3-3
[45] Groundwater Management Plan, Figures 3-3 to 3-6, pp. 3-3 to 3-6

2. Groundwater Conditions

The GSP Regulations require a description of historical and current groundwater conditions in the basin that includes information related to groundwater elevations, groundwater storage, seawater intrusion, groundwater quality, subsidence, and interconnected surface water, as applicable. The GSP Regulations also require an identification of groundwater dependent ecosystems.[46]

The Groundwater Management Plan characterizes current and historical groundwater conditions in the Llagas Subbasin, including groundwater elevations, land subsidence, surface water and groundwater interactions, and water quality.[47] Additional or supporting information regarding groundwater conditions in the Basin are provided in the District's 2015 Annual Report, online historical groundwater elevation data, Salt and Nutrient Management Plan, and the 2015 Urban Water Management Plan which were submitted to the Department as part of the Alternative.

The District provides information about current groundwater elevations in contour maps representing spring and fall conditions from its most recent annual report,[48] and provides maps from 2012 in the Plan, which the District describes as characterizing "typical" Subbasin conditions.[49] These maps illustrate the general groundwater flow directions and the change in seasonal flow patterns associated with recharge operations and typical pumping conditions and depressions. The Plan provides a hydrograph from an "index well" that illustrates periods of drawdown during droughts in the late 1970s and late 1980s/early 1990s followed by subsequent recovery, as well as drawdown beginning in 2011 following the recent drought. Historical Groundwater Elevation Data, showing groundwater elevation trends for wells monitored in the Subbasin, is made available online for public review.[50]

The District estimated the operational storage in the Subbasin to range between 152,000 to 165,000 acre-feet based on estimated aquifer properties of specific yield, area, and groundwater elevation changes.[51] The range was based on a high and low water elevation for years 1982-1983 and 1976-1977, respectively. The District does not provide an estimate of the total Subbasin storage but states that the operational range of storage was set to be less than total Subbasin storage to avoid adverse impacts.[52] The Groundwater Management Plan presents a graphical representation of the annual

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[46] 23 CCR § 354.16
[47] Groundwater Management Plan, Section 3.2, p. 3-8
[48] 2015 Annual Groundwater Report, Figures 14, 15, 16, pp. 21-23
[49] Groundwater Management Plan, Section 3.2.1, p. 3-8
[50] Historical Groundwater Elevation Data, https://gis.valleywater.org/GroundwaterElevations/map.php
[51] Groundwater Management Plan, Section 4.4.2.3, p. 4-16
[52] Groundwater Management Plan, Section 4.4.2.3, p. 4-16

change in storage from 1987 to 2016.[53] The Plan described that numerical modeling estimations of operational storage will be evaluated to determine if refinement of the operational storage estimate is necessary.

The Plan describes that a 2005 study by researchers from University of California, Berkeley, found no evidence of long-term subsidence.[54] The study evaluated InSAR satellite imagery from the period from 1992 to 2000 and, while elastic subsidence was observed during seasonal wet and dry conditions, no inelastic subsidence was found.[55]

The Plan identifies the Llagas Subbasin as an interior subbasin that is not located near any saltwater bodies and, therefore, the Subbasin is not vulnerable to seawater intrusion (*see* Seawater Intrusion, below).[56]

The Groundwater Management Plan describes and characterizes water quality conditions within the Llagas over the period of 2006 to 2015 and states that the District has monitored water quality conditions regularly since the 1980's.[57] The District maintains a water quality monitoring network of 36 wells in the Subbasin, but also includes water quality data from public water supply wells, domestic well testing, recycled water monitoring programs, and from other regulatory agencies (*see* Monitoring Networks, below).[58] The Groundwater Management Plan includes maps showing the distribution of key constituents with respect to maximum contaminant levels (MCL) and secondary maximum contaminant level (SMCL).[59] The Plan states that the groundwater in the Subbasin is generally of good quality and does not require treatment beyond disinfection at public water supply wells.[60] However, the Plan identifies that nitrate and perchlorate detections in domestic wells presents an "ongoing groundwater protection challenge".[61] Perchlorate is noted to be from a former highway safety flare plant and the Plan states that the District's recharge activities, removal of perchlorate from the source area, and other remediation efforts have combined to reduce the occurrence in the Subbasin, with fewer than 10 domestic wells requiring treatment or replacement water sources.[62] Nitrate in the Subbasin is attributed to man-made sources including application of fertilizers and from septic systems. A map of nitrate concentrations in the Plan indicates that elevated concentrations occur

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[53] Groundwater Management Plan, Figure 4-13, p. 4-16
[54] Bürgmann and Johanson, South County Subsidence Study – Phase I and Phase II, University of California, Berkeley, 2005.
[55] Groundwater Management Plan, Section 3.2.2, p. 3-10
[56] Groundwater Management Plan, Section 3.2.5, p. 3-19
[57] Groundwater Management Plan, Section 3.2.4, p. 3-12
[58] Groundwater Management Plan, Section 7.3.1.1, p. 7-9
[59] Groundwater Management Plan, Figures 3-14 and 3-15, pp. 3-15 to 3-16
[60] Groundwater Management Plan, Section 3.2.4, p. 3-12
[61] Groundwater Management Plan, Section 3.2.4, p. 3-12
[62] Groundwater Management Plan, Figure 3-13, p. 3-14

throughout the Subbasin.[63] The District has a nitrate treatment system rebate program to promote the purchase and installation of nitrate treatment systems for domestic well owners.[64]

In association with the Districts' recycled water program, a detailed analysis of the Subbasin-wide salt and nutrient loading was presented in the Salt and Nutrient Management Plan. The Salt and Nutrient Plan was prepared with respect to the Central Coast Regional Water Quality Control Board's Basin Plan water quality objectives for identified beneficial uses and users. The Salt and Nutrient Management Plan presents additional information regarding the existing and projected trends of total dissolved solids and nitrates associated with additional salt and nutrient loading within the Basin using an assimilative capacity analysis.[65] The Groundwater Management Plan provides a map of locations of known contaminated sites managed by other regulatory agencies.[66]

As described in the Groundwater Management Plan, the District utilizes the creeks and streams as part of its management practices to recharge groundwater in the Subbasin.[67] The District describes that its recharge activities are an important factor in maintaining flows in the surface water bodies in the Subbasin, many of which would only flow intermittently in the absence of that recharge.[68] Surface water bodies are described as being generally disconnected from groundwater and the District states they are not aware of any areas where groundwater pumping has a significant or unreasonable effect on interconnected surface water.[69]

The Plan describes two prominent wetlands along the southern Subbasin boundary. The Uvas-Carnadero wetlands are located in the southwestern corner of the Subbasin and represent an area of groundwater upwelling as it flows south into San Benito County. The Soap Lake area wetlands are located along the southeastern boundary and their source of water is believed to be from flooding and poorly draining soils.[70] The District provides a historical ecology map to serve as an indicator of historic stream conditions and vegetation types that may have once been associated with shallow groundwater.[71] The Plan presents a map of depth to first groundwater based on leaking underground storage

[63] Groundwater Management Plan, Figure 3-14, p. 3-15
[64] Groundwater Management Plan, Section 6.2.4, p. 6-12
[65] Salt and Nutrient Management Plan, Section 4.3, p. 20
[66] Groundwater Management Plan, Figure 6-2, p. 6-17
[67] Groundwater Management Plan, Section 2.2.3, p. 2-17
[68] Groundwater Management Plan, Section 2.2.3, p. 2-14
[69] Groundwater Management Plan, Section 3.2.3, p. 3-10
[70] Groundwater Management Plan, Section 3.2.3, p. 3-10
[71] Groundwater Management Plan, Figure 3-11, p. 3-11

tank sites, indicating where shallow groundwater may occur and be associated with surface water.[72]

3. Water Budget

GSP Regulations require a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored, as applicable.[73]

The Groundwater Management Plan provides a description of countywide water supply, demand, and management for both the Santa Clara and the Llagas subbasins.[74] The Plan provides a quantification of the groundwater budget summarizing natural and managed inflows and outflows for a period of 2003 through 2012. This 10-year period was selected due to a representative distribution of dry, wet, and normal years, without incorporating periods of exceptionally dry years.[75] Over that period, the Llagas Subbasin had a total inflow of approximately 47,000 acre-feet per year, with 24,000 acre-feet per year coming from managed recharge sources, and a total outflow of 47,000 acre-feet per year, with 44,000 acre-feet per year attributed to groundwater pumping and 3,000 acre-feet per year discharging to the adjacent basin. The average change in storage over that time period was zero.[76] The Plan notes that the groundwater budget was developed through use of a groundwater flow model, which is briefly described in the Plan.[77] Additional detail on the model as it was originally developed in 2005 was found in the consultant report, although the Plan indicates the model has been updated since that time.[78]

Anticipated future demands are described in the Plan and the 2015 Urban Water Management Plan. The Plan describes that municipal demand is projected to increase from the “current long-term average” of 44,000 acre-feet per year to 47,000 acre-feet per year by 2020 and then to 53,000 acre-feet per year by 2040; no change is expected for agricultural and “independent (non-retailers)” pumpers.[79] The 2015 Urban Water Management Plan provides descriptions of projected water demand through 2040 for various water use sectors which, consistent with the descriptions in the Groundwater

[72] Groundwater Management Plan, Figure 3-12, p. 3-12
[73] 23 CCR § 354.18
[74] Groundwater Management Plan, Sections 4.1 to 4.3, pp. 4-1 to 4-6
[75] Groundwater Management Plan, Section 4.4, p. 4-7
[76] Groundwater Management Plan, Table 4-6, p. 4-17
[77] Groundwater Management Plan, Section 7.6.2, p. 7-32
[78] CH2MHill, Llagas Basin Numerical Groundwater Model Report, 2005 – Entire Report
[79] Groundwater Management Plan, Section 4.5, p. 4-18

Management Plan, indicates an anticipated steady increase in population and water demand by water retailers.[80]

4. Management Areas

GSP Regulations authorizes, but does not require, an agency to define one or more management areas within a basin if the agency has determined that creation of management areas will facilitate implementation of the GSP.[81]

The District did not identify any specific management areas for the Llagas Subbasin in its Groundwater Management Plan.

C. Sustainable Management Criteria

GSP Regulations require a sustainability goal that defines conditions that constitute sustainable groundwater management for the basin, the characterization of undesirable results, and establishment of minimum thresholds and measurable objectives for each applicable sustainability indicator, as appropriate.[82]

1. Sustainability Goal

GSP Regulations require that sustainable management criteria include a sustainability goal that culminates in the absence of undesirable results within the appropriate timeframe, and includes a description of the sustainability goal, describes information used to establish the goal for the basin, describes measures that will be implemented to ensure the basin operates within its sustainable yield, and contains an explanation of how the sustainability goal will be met.[83]

The Groundwater Management Plan describes the correlation of the sustainable management criteria defined in SGMA with the driving principles of the District Act.[84] The Plan identifies two sustainability goals: (1) “groundwater supplies are managed to optimize water supply reliability and minimize subsidence”, and (2) “groundwater is protected from contamination, including salt water intrusion”.[85] The implementation of groundwater management activities associated with the District Act resulted in establishing organizational terminology and policy to implement the necessary actions to

[80] 2015 Urban Water Management Plan, Section 4.2, p. 4-2
[81] 23 CCR § 354.20
[82] 23 CCR § 354.22
[83] 23 CCR § 354.24
[84] Groundwater Management Plan, Section 5.1, p. 5-1
[85] Groundwater Management Plan, Section 5.2, p. 5-2

achieve these objectives. Figure 5-1 and 5-2 of the Plan illustrate the policy framework and definitions of the sustainability goals down to specific measurable outcomes.[86]

2. Sustainability Indicators

GSP Regulations specify that an agency define conditions that constitute sustainable groundwater management for a basin, including the characterization of undesirable results and the establishment of minimum thresholds and measurable objectives for each applicable sustainability indicator.[87]

Sustainability indicators are defined as any of the effects caused by groundwater conditions occurring throughout the basin that, *when significant and unreasonable*, cause undesirable results.[88] Sustainability indicators thus correspond with the six undesirable results – chronic lowering of groundwater levels indicating a depletion of supply if continued over the planning and implementation horizon, reduction of groundwater storage, seawater intrusion, degraded water quality, including the migration of contaminant plumes that impair water supplies, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have adverse impacts on beneficial uses of the surface water[89] – but refer to groundwater conditions that are not, in and of themselves, significant and unreasonable. Rather, sustainability indicators refer to the effects caused by changing groundwater conditions that are monitored, and for which criteria in the form of minimum thresholds are established by the agency to define when the effect becomes significant and unreasonable, producing an undesirable result.

This section thus consolidates three facets of sustainable management criteria: undesirable results, minimum thresholds, and measurable objectives. Information pertaining to the processes and criteria relied upon to define undesirable results applicable to the basin, as quantified through the establishment of minimum thresholds, are addressed for each sustainability indicator. However, a submitting agency is not required to establish criteria for undesirable results that the agency can demonstrate are not present and are not likely to occur in a basin.[90]

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[86] Groundwater Management Plan, Section 5.1, pp. 5-1 to 5-2
[87] 23 CCR § 354.22
[88] 23 CCR § 351(ah)
[89] Water Code § 10721(x)
[90] 23 CCR § 354.26(d)

a. Chronic Lowering of Groundwater Levels

GSP Regulations specify that the minimum threshold for chronic lowering of groundwater levels be based on groundwater elevations indicating a depletion of supply that may lead to undesirable results.[91]

The District does not manage the Subbasin to specific groundwater-level thresholds. Instead, the District uses a threshold for end-of-year groundwater storage (*see* Reduction of Groundwater Storage, below). However, water levels are monitored throughout the year to "support groundwater supply assessment and forecasting, recharge operations, efforts to monitor concentrated pumping and land subsidence, and other purposes."[92]

b. Reduction of Groundwater Storage

GSP Regulations specify that the minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results.[93]

The Groundwater Management Plan describes an end-of-year groundwater storage target of 17,000 acre-feet for the Llagas Subbasin.[94] The District's Functional Equivalency Report cites the sections of the Plan describing the storage targets as being equivalent to the minimum thresholds required in a GSP.[95] The storage targets were derived from the District's 2015 Urban Water Management Plan, which identified a combined storage target of 300,000 acre-feet for the Santa Clara and Llagas subbasins as the bottom of the "normal" range where no contingency actions are needed.[96] The Urban Water Management Plan provides additional details of the storage analysis and describes subsequent contingency actions to be taken if the end-of-year storage targets are not met.[97] The 2015 Annual Groundwater Report describes that the end-of-year storage volumes were not met in 2015 (a drought year), when a total of approximately 13,900 acre-feet of groundwater was in storage.[98] This condition triggered a countywide water use reduction of 30 percent in 2015, which was reduced to a 20 percent reduction in 2016; the water use reduction triggers were described as being consistent with District's Water Shortage Contingency Plan.[99]

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[91] 23 CCR § 354.28(c)(1)
[92] Groundwater Management Plan, Section 7.1.1, p. 7-1
[93] 23 CCR § 354.28(c)(2)
[94] Groundwater Management Plan, Section 5.4.1, p. 5-6
[95] Groundwater Management Plan, Appendix B, p. B-13
[96] Groundwater Management Plan, Section 5.4.1, p. 5-6
[97] 2015 Urban Water Management Plan, Table 8-1, p. 8-3
[98] 2015 Annual Groundwater Report, Section 3.2, p. 24
[99] 2015 Annual Groundwater Report, Section 3.2, p. 19

c. Seawater Intrusion

GSP Regulations specify that the minimum threshold for seawater intrusion be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.[100]

As noted above (*see* Groundwater Conditions), the District identified that the Llagas Subbasin is not vulnerable to seawater intrusion due to the landlocked, interior location of the subbasin and no criteria for this sustainability indicator were provided in the Plan.

d. Degraded Water Quality

GSP Regulations specify that the minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the agency that may lead to undesirable results.[101]

The Plan describes two water quality outcome measures for the plan area, which covers both the Santa Clara and Llagas subbasins. The first outcome measure is that at least 95 percent of countywide water supply wells meet primary drinking water standards and 90 percent of wells in the "South County" area (comprised of the Llagas Subbasin and the adjacent Coyote Valley management area of the Santa Clara Subbasin) meet agricultural objectives defined in the Regional Water Quality Control Board's Basin Plan.[102] The Plan describes that this outcome measure is primarily related to groundwater that is used (i.e., extracted) and, because most groundwater is extracted from the principal aquifer zone, only wells in that zone are tracked for this measure.[103] The 2015 Annual Report describes that the drinking water component of this outcome measure was not met in 2015, when 84 percent of wells met primary drinking water standards.[104] The 2015 Annual Report explained that all of the instances where drinking water standards were not met were due to nitrate detections in domestic wells located in the "South County" area. The agricultural water quality component of the outcome measure was met in 2015, with 98 percent of wells meeting agricultural water quality objectives.

The second outcome measure is that at least 90 percent of wells county-wide in both the shallow and principal aquifer zones have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.[105] The 2015 Annual Report describes that the nitrate and total dissolved solids components of this outcome measure were met in 2015, but

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[100] 23 CCR § 354.28(c)(3)
[101] 23 CCR § 354.28(c)(4)
[102] Groundwater Management Plan, Section 5.4.3, p. 5-7
[103] Groundwater Management Plan, Section 5.4.3, p. 5-7
[104] 2015 Annual Groundwater Report, Section 5, p. 34
[105] Groundwater Management Plan, Section 5.4.3, p. 5-8

that it was not met for chloride, when 84 percent of wells showed stable or decreasing chloride concentrations.

e. Land Subsidence

GSP Regulations specify that the minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results.[106]

The District has not provided sustainable management criteria for subsidence in the Llagas Subbasin. As noted above (*see* Groundwater Conditions), the Plan states that technical studies support that there is no evidence for long-term inelastic subsidence in the Subbasin.[107]

f. Depletion of Interconnected Surface Water

GSP Regulations specify that the minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.[108]

The Plan does not identify any management criteria related to depletions of interconnected surface water in the Llagas Subbasin. The District notes that streams and creeks in the Subbasin are largely disconnected and that flows in those surface water bodies would only occur intermittently if not for the District's recharge activities.[109] The Plan identifies that interconnected surface water potentially only occurs in a discrete southwestern wetland area of the Llagas Subbasin associated with the area where groundwater discharges south into San Benito County (*see* Groundwater Conditions, above).

D. Monitoring Networks

GSP Regulations require that each basin be monitored, and that a monitoring network include monitoring objectives, monitoring protocols, and data reporting requirements be developed that shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions.[110]

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[106] 23 CCR § 354.28(c)(5)
[107] Groundwater Management Plan, Section 3.2.2, p. 3-10
[108] 23 CCR § 354.28(c)(6)
[109] Groundwater Management Plan, Section 3.2.3, p. 3-10
[110] 23 CCR § 354.32

The District describes the groundwater level, water quality, and surface water (flow and quality) monitoring programs in place to measure progress or maintenance of the District's outcome measures and sustainability goals.

Groundwater level monitoring includes a network of 58 wells distributed throughout the Subbasin and monitored directly by the District.[111] The District provides descriptions of the monitoring well network including total depth, screen interval (provided for less than half of the monitoring wells), well type, monitoring frequency, and other details.[112] Nearly all of the District monitoring wells are monitored no less frequent than monthly. The Groundwater Management Plan provides a description of the accuracy associated with various methods used to determine wellhead elevation (i.e., wellhead survey, interpolation from topographic maps, or interpolation from lidar data.[113] The Plan notes that wellhead elevations for approximately half of the wells monitored by the District were determined by surveying, which is the method associated with the highest accuracy, and that the District is working to survey the remaining wells as resources allow.[114]

The District maintains a water quality monitoring network of 36 wells[115] (15 in the shallow aquifer zone and 21 in the principal aquifer zone) that are sampled annually for trace elements, ions, nutrients, and field parameters (e.g., pH, specific conductance, and temperature), and every three years for volatile organic compounds.[116] The District also obtains water quality sampling results from public water supply wells,[117] domestic wells tested as part of the District's free basic water quality testing program,[118] recycled water monitoring programs,[119] and groundwater quality data from other regulatory agencies (including the Water Board's Groundwater Ambient Monitoring and Assessment and Irrigated Lands Regulatory Program).[120]

Surface water monitoring described by the District includes the evaluation of water quality and discharge of surface waters within the Subbasin to properly manage recharge efforts.[121] The District identifies the sampling locations for water quality and discharge

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[111] Groundwater Management Plan, Section 7.1.1, pp. 7-1 to 7-3
[112] Groundwater Management Plan, Appendix E, p. E-13
[113] Lidar (or LiDAR) refers to "light detection and ranging", a laser-based remote-sensing technology that is capable of penetrating overlying vegetation and forest canopies. (Arlen F. Chase, et al., Geospatial revolution in Mesoamerican archaeology, Proc. Nat. Acad. Sciences, Aug 2012, 109 (32) 12916-12921; DOI: 10.1073/pnas.1205198109x)
[114] Groundwater Management Plan, Section 7.1.2.1, p. 7-3
[115] Groundwater Management Plan, Section 7.3.1.1, p. 7-9
[116] Groundwater Management Plan, Section 7.3, p. 7-9
[117] Groundwater Management Plan, Section 7.3.2, p. 7-13
[118] Groundwater Management Plan, Section 7.3.3, p. 7-14
[119] Groundwater Management Plan, Section 7.3.4, p. 7-15
[120] Groundwater Management Plan, Section 7.3.5, pp. 7-19 to 7-20
[121] Groundwater Management Plan, Section 7.4.1, p. 7-23

locations throughout the Subbasin.[122] Water quality samples are collected at six stream recharge system sites on a triennial rotating basis during both dry and wet seasonal conditions with 90 samples being collected in total over the three-year period (District wide).[123] In addition to collecting surface water quality and discharge data, the District coordinates and incorporates data from other agencies and programs including the Central Coast Regional Water Quality Control Board's Ambient Monitoring program.

Data collected as part of the District's monitoring programs are stored in databases and are largely available on the District's websites. The monitoring data is incorporated into various reporting structures that regularly inform management actions by the District, these include: Water Tracker (monthly), Monthly Groundwater Condition Report, Protection and Augmentation of Water Supplies Report (annual), and the Annual Groundwater Report.[124] These data and reports support ongoing modelling efforts to support the District's forecasting ability and ongoing evaluation of conditions in the Subbasin.

E. Projects and Management Actions

GSP Regulations require a description of the projects and management actions the submitting agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.[125]

The Groundwater Management Plan provides a portfolio of projects and management actions that are currently being implemented by the District or other agencies to address County-wide sustainability goals. The District also explains that the District Act provides the authority to advance additional projects on an as-needed basis through the capital improvement program.[126] The Plan organizes these projects and management actions into three primary categories: projects supporting groundwater reliability, groundwater quality, and surface water - groundwater interactions.

Programs to maintain reliable groundwater supply include managed aquifer recharge, in-lieu recharge, protection of natural recharge, groundwater production management, water accounting, groundwater level and storage assessments, and asset management.[127] Programs to protect groundwater quality include a well ordinance program, domestic well testing program, salt and nutrient management, nitrate treatment system rebate program,

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[122] Groundwater Management Plan, Figure 7-14, p. 7-25
[123] Groundwater Management Plan, Section 7.4, p. 7-23
[124] Groundwater Management Plan, Section 7.5, p. 7-28
[125] 23 CCR § 354.44
[126] Groundwater Management Plan, Section 6.0, p. 6-1
[127] Groundwater Management Plan, Section 6.1, p. 6-1

vulnerability assessment studies, coordination with land use agencies, coordination with regulatory agencies, and public outreach.[128] Programs related to surface water - groundwater interaction provide ongoing integrated management of these resources serve to address both reliability and quality needs of the beneficial uses and users in the Basin and include the managed in-stream releases of surface water, stormwater management, prevention of salt water intrusion, and watershed management.[129]

VI. Assessment

The following describes the evaluation and assessment of the Alternative for the Llagas Subbasin as determined by Department staff. In undertaking this assessment, Department staff do not conduct geologic or engineering studies, although Department staff may rely on publicly available geologic or engineering or other technical information to verify claims or assumptions presented in the Alternative.[130] As discussed above, Department staff have determined that the Llagas Alternative satisfied the conditions for submission of an alternative.[131] The Alternative was submitted within the statutory period, the Subbasin was found to be in compliance with the reporting requirements of CASGEM, and staff find the Alternative to be complete and to cover the entire basin (*see* Required Conditions, above). Based on its evaluation and assessment of the Llagas Alternative, as discussed below, Department staff find that the Alternative satisfies the objectives of SGMA.[132]

A. Evaluation of Alternative Contents

The District describes in sufficient detail its authority to manage groundwater within its statutory boundaries, which encompasses the Llagas Subbasin. The Groundwater Management Plan and the District Act document the legal authority and describe past and planned future authority to implement and finance necessary projects. The District describes the evolution of the District dating back to 1929 with the Santa Clara Valley Water Conservation District charged with the initial mission of stopping groundwater overdraft and subsidence. Since that time the District has grown through consolidation and annexation of other flood control and water districts. The District has demonstrated implementation of numerous projects and management actions to address the primary drivers of flood control, water reliability, and water quality conditions in the County. The District has funded and cooperated with numerous studies to characterize groundwater

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[128] Groundwater Management Plan, Section 6.2, p. 6-9
[129] Groundwater Management Plan, Section 6.3, p. 6-18
[130] Instances where the Department review relied upon publicly available data that was not part of the Alternative are specifically noted in the assessment.
[131] 23 CCR § 358.4(a)
[132] Water Code § 10733.6(a); and 23 CCR § 358.4(b)

conditions in the County for a variety of factors to inform management strategies. That history of management in the County provides a reasonable level of confidence that the District can continue implementation of the Groundwater Management Plan to meet its sustainability goals.

The Groundwater Management Plan and associated technical studies and plans demonstrate a sufficient understanding of the basin setting, including the geology and groundwater conditions of the Llagas Subbasin. The Plan and supporting technical studies, including the 2015 Annual Report, 2015 Urban Water Management Plan, and the Salt and Nutrient Management Plan appear to rely on best available information and best available science, and their conclusions are consistent with the Department's understanding of conditions in the Llagas Subbasin. The hydrogeologic conceptual model described in the Plan incorporates the relevant hydrologic processes in the entire basin to support analysis presented. The use of numerical models in the Basin to support operational and long-term planning decisions also provide support for water budget estimates. The District's numerical models are used to provide on-going estimates of groundwater storage to support management actions of required replenishment activities. The District's understanding of the basin setting is adequate to develop and implement a plan for sustainable groundwater management. However, Department staff recommend the District address identification of groundwater dependent ecosystems (*see* Recommended Action 1) and incorporate climate change into its projected water budget (*see* Recommended Action 2).

The Plan identifies sustainability goals for the County and specific, quantitative outcome measures for groundwater storage in the Llagas Subbasin and water quality in the combined Santa Clara and Llagas subbasins. The District's storage outcome measure is an end-of year storage target of 17,000 acre-feet in the Llagas Subbasin. The District has identified specific actions that occur if that storage target is not met, as defined in the 2015 Urban Water Management Plan. Water quality outcome measures utilize primary drinking water standards and Central Coast Regional Water Quality Control Board Basin Plan agricultural water quality standards. The water quality outcome measure address both the number of detections above the identified thresholds and trends of key constituents identified for the County. Department staff recommend that the water quality outcome measures, which in the Plan are defined County-wide (i.e., they are set based on water quality in both the Santa Clara and Llagas subbasins), be refined in future updates to the Alternative with separate quantitative measures specific to the respective subbasins (*see* Recommended Action 3). The District already reports water quality detections and trends separately by subbasin but, as presently configured in the Plan, it is not possible to determine whether failure to achieve the outcome measures represents

an undesirable result for both subbasins or whether the undesirable result is applicable to a specific subbasin.[133]

Additionally, the outcome measures defined by the District are the only quantitative standards outlined in the Plan and, as indicated in the 2015 Annual Groundwater Report, several of those standards were not met in 2015 (e.g., for end-of-year storage). While alternatives are not required to follow the exact format of a GSP, the GSP Regulations do outline a process for GSP development that includes quantitative standards both for measurable objectives, which represent conditions that the basin is operated toward; and minimum thresholds, which represent conditions that generally are to be avoided so as to not cause undesirable results. It was not clear to Department staff whether those outcome measures were generally more equivalent to measurable objectives or minimum thresholds but, in the absence of any other quantifiable standard, the Department's ongoing review of whether the Alternative satisfies the objectives of SGMA will focus on whether the District is able to meet those outcomes to avoid undesirable results in the Subbasin. If the outcome measures are more equivalent to measurable objectives and there is another metric that is generally more representative of conditions that the District intends to avoid in the Subbasin to prevent undesirable results, then the District should provide those metrics in an update to the Alternative (*see* Recommended Action 4).

The District describes specific monitoring networks that address groundwater levels, groundwater quality, surface water quality, and surface water flows and the data collected from these locations typically represent long periods of observations. The distribution of dedicated monitoring wells and other monitoring sites appears to be reasonable based upon the description of the hydrogeologic system. The data provide an adequate and reasonable distribution of direct observations of conditions within the Basin to allow for informed decisions and planning for sustainable groundwater management. The frequency of data collected from the monitoring networks is adequate to characterize the seasonal variability and management-action based variability of the groundwater and related systems.

The District's management actions and projects related to groundwater management, which include direct managed recharge, in-lieu recharge, protection of natural recharge, management of groundwater production, water accounting, groundwater storage assessments, and asset management (i.e., maintenance of infrastructure) appear to have resulted in significant progress in meeting County-wide sustainability goals and toward meeting the outcome measures for storage and water quality applicable to the Llagas Subbasin. The groundwater conditions described in the Plan illustrate the maintenance of the targeted conditions, with exception of drought periods where additional prescribed

[133] 2015 Annual Groundwater Report, Table 8, p. 37

actions were implemented, such as water conservation and withdrawal of banked water. Continued implementation of planned projects, programs, and coordinated effort on water quality objectives will likely result in continued progress toward meeting the goals and outcome measures. The District describes a clear process for development, funding, and implementation of necessary projects to support the sustainability goals.

The Groundwater Management Plan for the Llagas Subbasin is specifically designed to manage groundwater supplies to optimize water supply reliability and to protect the basin against undesirable results including overdraft and groundwater contamination, and so appears consistent with Water Code Section 106.3, which establishes the state policy that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." Department staff consider that the Groundwater Management Plan, which utilizes natural waterways in the basin to recharge the aquifers, appears also to be consistent with the public trust doctrine.

B. Recommended Actions

The following recommended actions include information that the District may wish to include in the first five-year update of the Alternative to facilitate the Department's ongoing evaluation and assessment of the Alternative as well as recommendations for improvements to the Alternative.

Recommended Action 1.

Staff recommend that the District provide an identification of groundwater dependent ecosystems in the Subbasin.

Recommended Action 2.

Staff recommend that the District provide a projected water budget incorporating climate change over the planning and implementation horizon of 50 years.

Recommended Action 3.

Staff recommend that the District create separate outcome measures related to water quality in the Santa Clara and Llagas subbasins. Separate subbasin-specific criteria will allow for a determination of whether each subbasin, separately, is meeting or making progress toward the outcome measures.

Recommended Action 4.

The District should clarify how meeting its outcome measures relates to the avoidance of undesirable results in the Llagas Subbasin. Specifically, it should clarify whether not meeting the outcome measures represents an undesirable result for the applicable sustainability indicator. If the intent of the outcome measures is not to represent

undesirable results, the District should provide additional clarification about their purpose. In addition, the District should provide metrics that it can use and can be used by the Department to objectively assess the presence or absence of undesirable results.

APPENDIX D

TECHNICAL MEMORANDUM

EVALUATION OF DRY SUPPLY WELLS DURING DROUGHT IN THE SANTA CLARA AND LLAGAS SUBBASINS

Prepared by:

Jason Gurdak, Ph.D., P.H.
Senior Water Resources Specialist

Chanie Abuye
Associate Engineer - Civil

Roger Pierno, P.E.
Associate Engineer - Civil

Under the Direction of:

Vanessa De La Piedra, P.E.

Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

October 2021

Executive Summary

This technical memo presents information on water supply wells that went dry during the 2012 to 2016 drought and evaluates the vulnerability of wells going dry in the Santa Clara and Llagas subbasins. This evaluation is based on analysis of water supply well completion depths, observed and estimated depth to groundwater, and wells reported as dry during the 2012 to 2016 drought.

During the 2012–2016 drought, only 0.23% (14 of 5,969) of active and standby water supply wells were reported dry. All 14 were domestic wells, including six wells in the Santa Clara Subbasin and two in the Llagas Subbasin. No agricultural or municipal and industrial (M&I) supply wells were reported dry. All the reported dry domestic wells are located along the subbasin margins where groundwater storage can be relatively low and water levels are more responsive to pumping stresses.

Based on water supply wells with available well depth information and as further described in this memorandum, an estimated 110 wells may have been vulnerable to going dry during the 2012–2016 drought. The Santa Clara Plain (northern Santa Clara Subbasin) had a fairly high number of very shallow wells (total depth less than 100 feet) and relatively larger percentage of wells that may have been at risk of going dry compared to the Coyote Valley or Llagas Subbasin. Like the reported dry domestic wells, the estimated 110 vulnerable supply wells are also primarily located along the subbasin margins.

The analysis described in this memo includes inherent uncertainty due to regional interpolation and limited data points and likely overestimates vulnerable supply wells. Interestingly, the wells actually reported as dry during the 2012–2016 drought were not identified as being vulnerable in this analysis, highlighting the challenge of using simplified approaches and interpolation over large regions. Valley Water will explore alternative analytical approaches to better understand potential supply well impacts from drought. However, the relatively small percentage of reported dry and estimated vulnerable supply wells and their locations indicate that Valley Water's management practices are maintaining sustainable groundwater conditions, even during drought. The findings from this study are being incorporated into the 2021 Groundwater Management Plan (GWMP) update.

1. Introduction

It is well documented that groundwater resources are often stressed because of climate variability and drought when surface-water resources become limited (Gurdak, 2017). For example, groundwater is California's largest source of storage (PPIC, 2018a) and statewide reliance on groundwater resources greatly increased relative to surface-water resources during the statewide 2012–2016 drought (PPIC, 2018b). Pumping stress on groundwater during drought results in the lowering of water levels in wells. If the pumping stress is severe or prolonged, water levels can fall below the well pump intake or well screen, effectively creating either temporary or permanent "dry well" conditions. Thousands of domestic wells, largely in the California's Central Valley, were reported dry during the 2012–2016 drought (Jesechko and Perrone, 2020). Depending on local groundwater management practices, groundwater levels can recover after the drought ends, resulting in only temporary, rather than permanent, dry well conditions (DWR, 2019). As described in this memo, only a very small number of domestic wells were reported as dry in the Santa Clara and Llagas subbasins during the 2012–2016 drought, largely due to Valley Water's proactive drought response and actions to quickly recover groundwater to pre-drought conditions.

1.1. Purpose and Scope

The purpose of this memo is to document Valley Water's evaluation to better understand where and how many supply wells went dry during the 2012-2106 drought and to determine the relative vulnerability of supply wells to drought. The analysis focuses on supply wells located inside the Santa Clara and Llagas subbasin boundaries, which is consistent with Valley Water's role as Groundwater Sustainability Agency for these subbasins. Major findings and recommendations from this memo will be presented in the 2021 GWMP, which will be submitted to the Department of Water Resources (DWR) as the required five-year update to Valley Water's approved Alternative to a Groundwater Sustainability Plan.

2. Methods

The evaluation presented in this memo is based on statistical and geographic information system (GIS) analysis of available supply well completion depths, observed and estimated depth to groundwater, and reported dry supply wells during the 2012 to 2016 drought. The observed depth to groundwater readings (groundwater levels) and supply well completion depths were compiled from Valley Water databases. It should be noted that Valley Water does not have completion depths for many wells that were installed prior to well permitting regulations, which took effect in the 1970s. Information on dry wells during the 2012 to 2016 drought were based on voluntary reports from to Valley Water from well owners. The following sections describe the data and approach used for this analysis.

2.1. Status, Depth, and Use of Water Supply Wells

Over 53,000 wells have been drilled in Santa Clara County and most of these are monitoring wells. Of the non-monitoring wells, a total of 6,189 are (or were) water supply wells located within the Santa Clara Subbasin (including the Santa Clara Plain and Coyote Valley groundwater management areas) and the Llagas Subbasin (Figure 1, Table 1). These supply wells are described in the next sections based on well status (active, standby, abandoned, and destroyed) and well use type (agricultural, domestic, monitoring, and municipal and industrial (M&I)). As described below, subsequent analyses focus on active or standby supply wells within the Santa Clara and Llagas subbasins for which well depth completion information is available.

2.1.1. Well Status

Well status is categorized as either active, standby, abandoned, or destroyed. Of the 6,189 supply wells, about 94% (5,835) are active wells, whereas the remainder have a well status of either standby (2%, 126), abandoned (0.45%, 28), or destroyed (3.2%, 200) (Figure 1, Table 1). There are approximately 2,600 abandoned and 24,000 destroyed wells in the Santa Clara and Llagas subbasins. Only 28 abandoned and 200 destroyed wells have completed well depth information (Figure 1, Table 1). Due to the differences in land use patterns and available water supply sources between the two subbasins, the majority (3,989) of the supply wells are in the relatively less urbanized Llagas Subbasin and 2,200 are in the more urbanized Santa Clara Subbasin (Table 1). Additional details about land use and corresponding well use type in the two subbasins are explained in the next sections.

Figure 1. Status of Water Supply Wells in the Groundwater Management Areas.

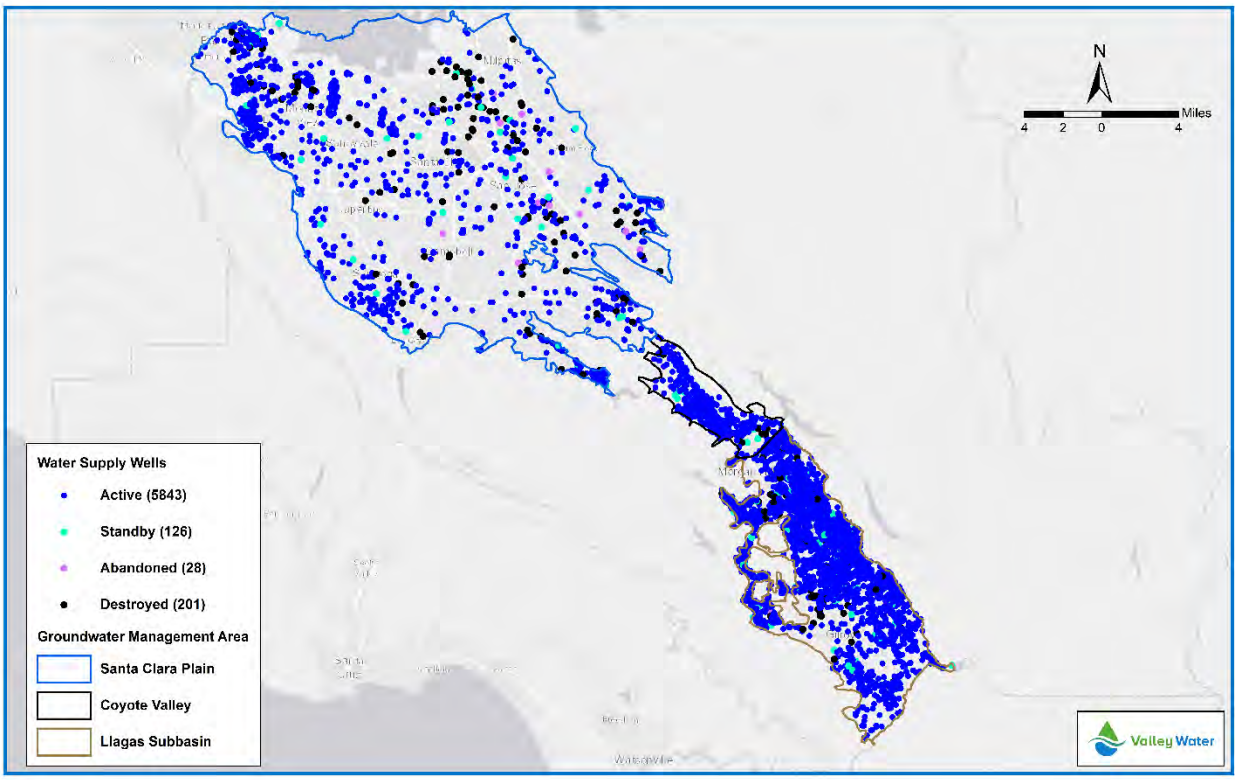


Table 1. Number and Status of Water Supply Wells in the Groundwater Management Areas.

Well Status	Santa Clara Subbasin		Llagas Subbasin	Total
	Santa Clara Plain	Coyote Valley		
Active	1,412	567	3,856	5,835
Standby	44	15	67	126
Abandoned	18	2	8	28
Destroyed	131	11	58	200
Total	1,605	595	3,989	6,189

Note: Abandoned and destroyed wells shown include only those with well construction information.

2.1.2. Well Depth

Similar to other groundwater basins in California, there are many supply wells in the Santa Clara and Llagas subbasins that do not have completed well depth information. Many of these wells were installed prior to State and Valley Water well regulations that require the reporting of well construction information upon installation. Of the 6,189 supply wells in the Santa Clara and Llagas subbasins, only 2,303, or 37%, have available completed well depth information (Figure 2, Table 2). Of these wells, the majority (62%, 1,427) are in the Llagas Subbasin and 38% (876) are in the Santa Clara Subbasin.

Figure 2. Water Supply Wells with Available Completed Well Depth Information in the Groundwater Management Areas.

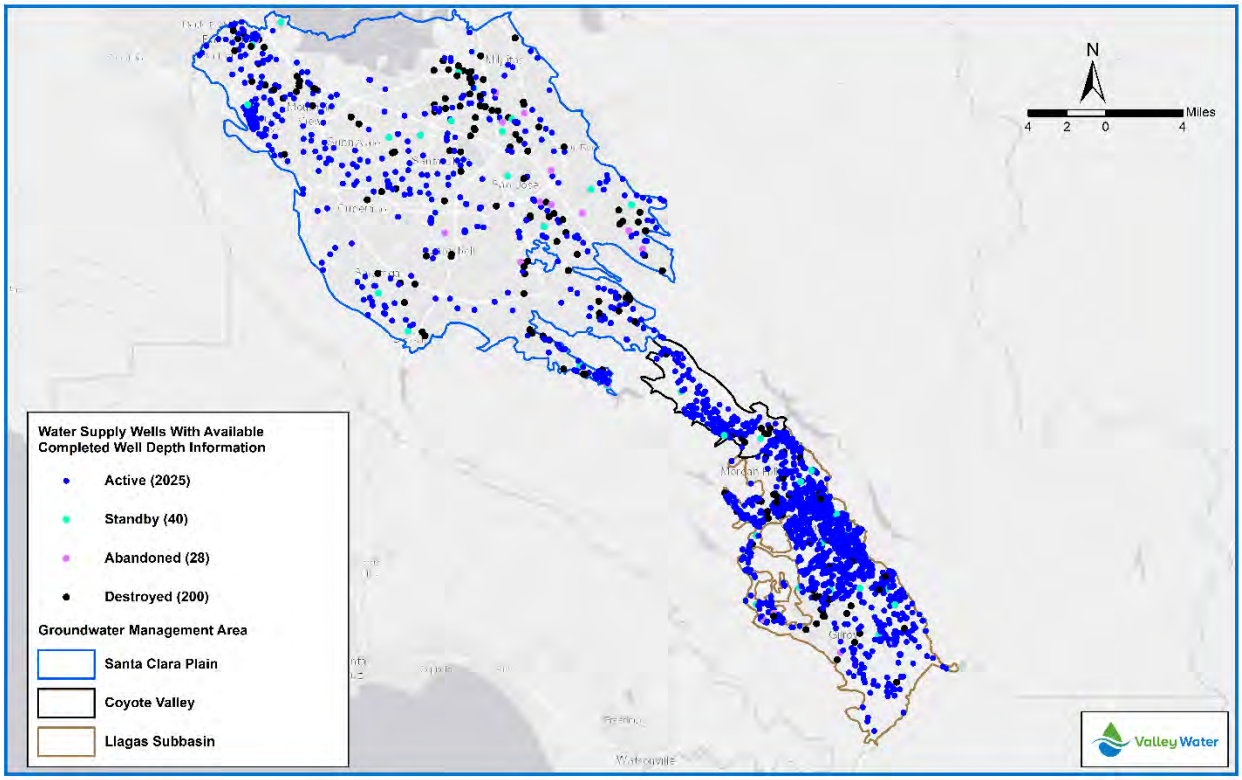


Table 2. Water Supply Wells with Completed Well Depth Information in the Groundwater Management Areas.

Well Status	Santa Clara Subbasin		Llagas Subbasin	Total
	Santa Clara Plain	Coyote Valley		
Active	508	181	1,346	2,035
Standby	21	4	15	40
Abandoned	18	2	8	28
Destroyed	131	11	58	200
Total	678	198	1,427	2,303

2.1.3. Well Use Type

Well use type is categorized in this memo as either agricultural, domestic, monitoring, or municipal and industrial (M&I). These four categories describe the dominant use of all supply wells and represent a simplification of the 32 unique well use type categories in Valley Water's Water Supply Planning Database. The 32 unique well use type categories reflect that many supply wells may be used for more than a single use. For example, some supply wells may be used for both domestic and agricultural uses. Similarly, many of the monitoring wells used in Valley Water's water level monitoring network are used primarily for agricultural, M&I, or domestic purposes. Therefore, the four simplified well use type categories were

selected based on the first well use type listed in each of the 32 unique well use type categories and assumes that is the dominant use of the supply well.

Table 3 compares well use type to well status for all 6,198 supply wells in the Santa Clara and Llagas subbasins regardless of whether the well has completed well depth information. Most active wells are domestic (4,001), followed by M&I (1,062) and agricultural (780). Most standby wells are also domestic (75), followed by agricultural (37) and M&I (14) (Table 3).

Table 3. Primary Use Type and Status for all Water Supply Wells in the Santa Clara and Llagas Subbasins.

Well Status	Well Use Type				
	Agricultural	Domestic	Municipal and Industrial (M&I)	Monitoring	Total
Active	780	4,001	1,062	--	5,843
Standby	37	75	14	--	126
Abandoned	10	18	--	--	28
Destroyed	55	97	46	3	201
Total	882	4,191	1,122	3	6,198

The Santa Clara Subbasin, especially the Santa Clara Plain, has relatively more urban and developed land use than the Llagas Subbasin, which has more agricultural and rural land use and includes large unincorporated areas not served by water retailers. These land use differences are reflected in the distribution of water supply well use types (Table 4, Figure 3). The Santa Clara Plain has the majority (67%, 310) of the M&I supply wells and the Llagas Subbasin has the majority of the agricultural (61%, 171) and domestic (73%, 1,128) supply wells with completed depth information (Table 4).

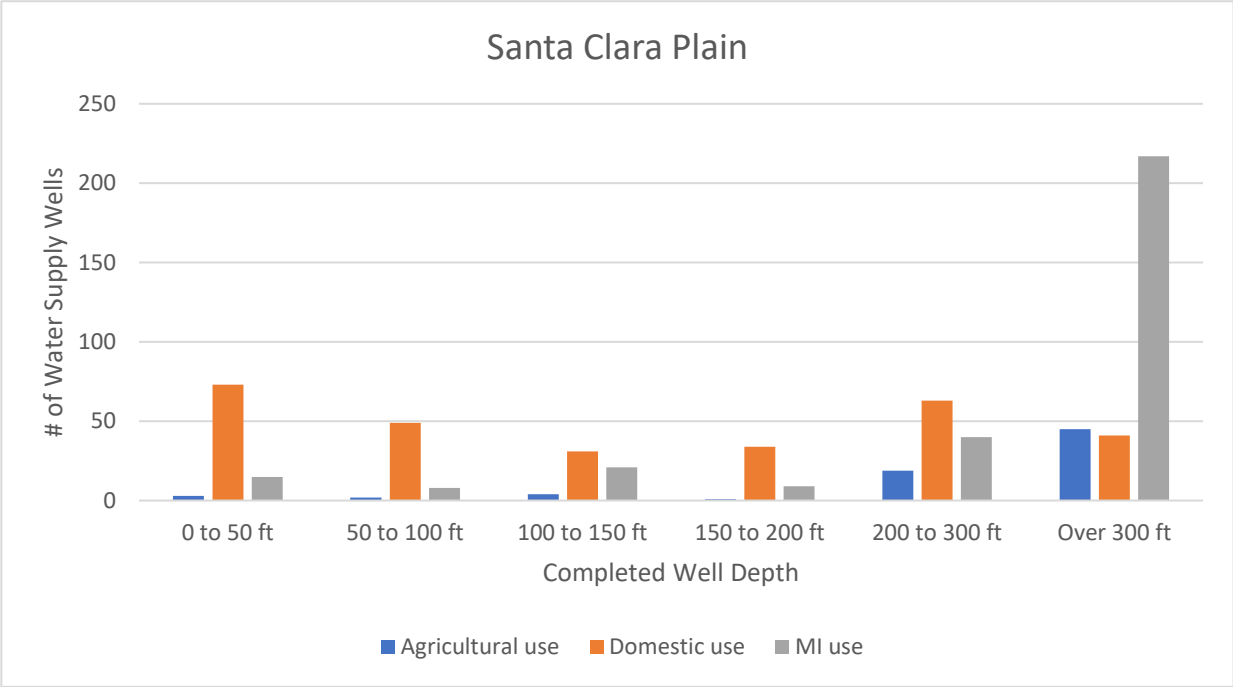
Table 4. Water Supply Well Use Type for Wells with Completed Depth Information in the Groundwater Management Areas.

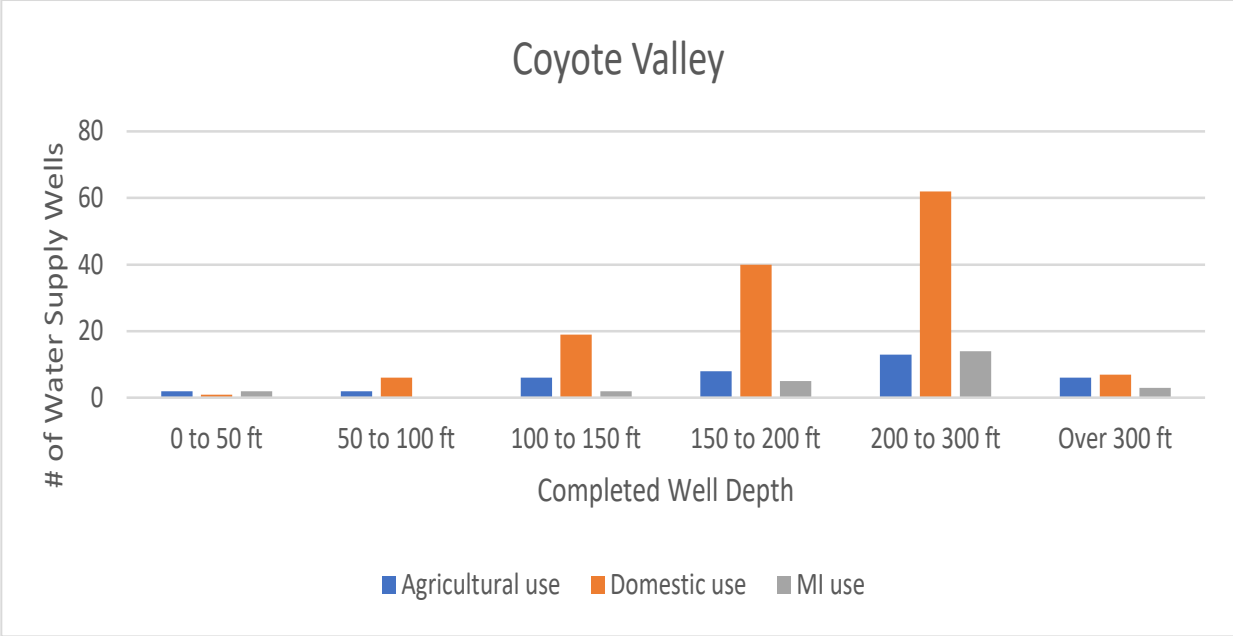
Well Use Type	Santa Clara Subbasin		Llagas Subbasin	Total
	Santa Clara Plain	Coyote Valley		
Agricultural	74	37	171	282
Domestic	291	135	1,128	1,554
M&I	310	26	128	464
Monitoring	3	--	--	3
Total	678	198	1,427	2,303

As shown in Figure 3, most water supply wells have total depth greater than 150 feet. However, available data indicates a surprising number of shallow water supply wells with total depth less than or equal to 100 feet: 150 in the Santa Clara Plain, 13 in the Coyote Valley, 111 in the Llagas Subbasin. In the Santa Clara Plain, 91 of these wells have total depth less than 50 feet making them more vulnerable not only to

going dry but also to contaminants at the land surface.[1] It should be noted that some of these shallow wells may be related to groundwater remediation sites, rather than truly serving as water supply wells. Figure 4 shows the spatial distribution of wells with very shallow total depth, which makes them more vulnerable to drought-induced reductions in groundwater levels.

Figure 3. Water Supply Well Depth by Well Use Type.





[1] Current Valley Water well standards require a minimum 50-foot annular seal, so wells this shallow would not be permitted.

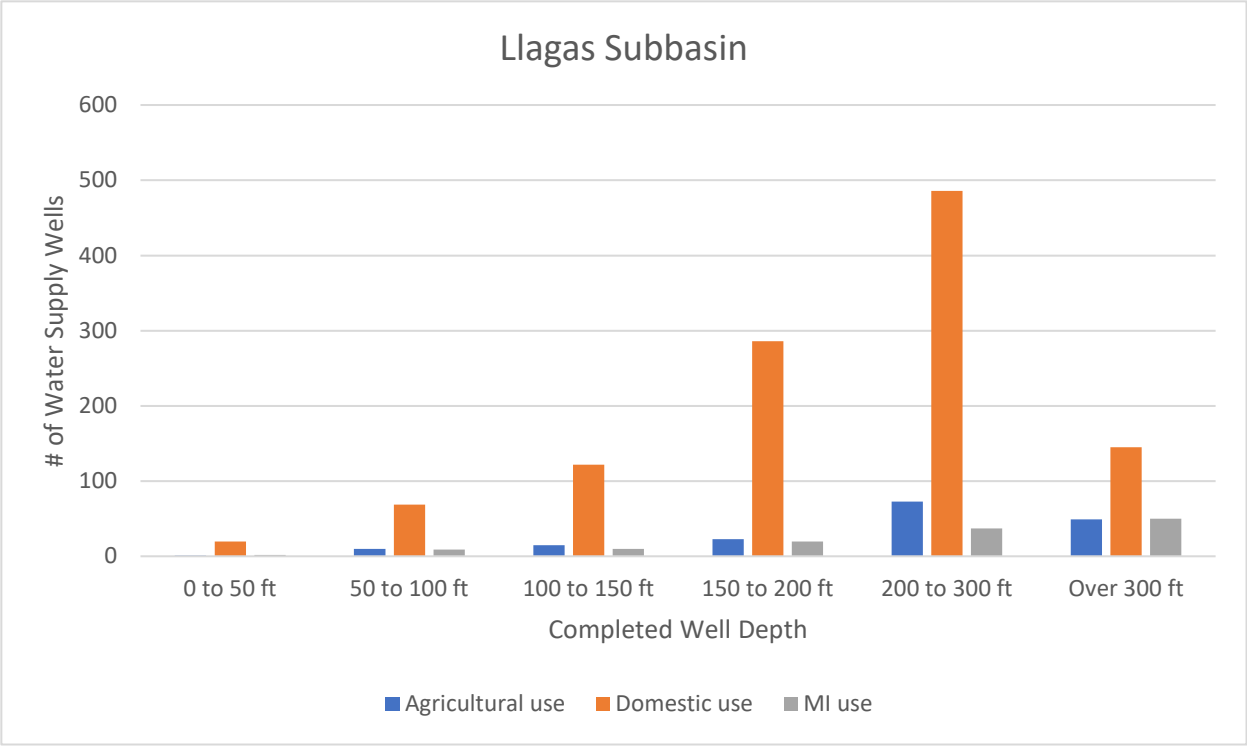
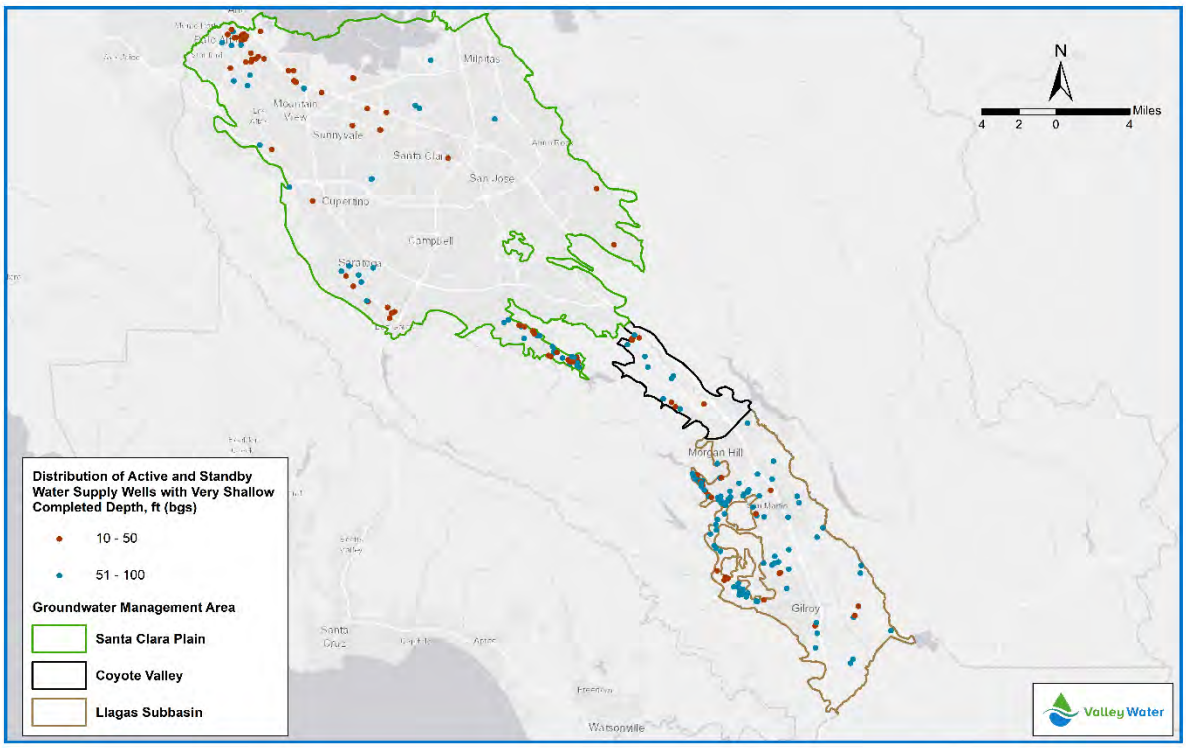


Figure 4. Spatial Distribution of Shallow Wells with Total Depth Less than 100 Feet.



2.2. Depth to Water During the 2012-2016 Drought

During the 2012–2016 drought, the maximum depth to water throughout the Santa Clara and Llagas subbasins occurred during 2014 and 2015, based on analysis of hydrographs from regional index wells and many other wells in the subbasins. Although the statewide drought continued through 2016, groundwater levels recovered in 2016 across much of the Santa Clara and Llagas subbasins because of Valley Water's groundwater management practices to quickly recover groundwater to pre-drought conditions.

In this analysis, the maximum depth to water readings in 2014 and 2015 were used to represent the most recent severe drought condition in supply wells across the Santa Clara and Llagas subbasins. A maximum depth to water surface was created in a GIS using the lowest observed water levels during 2014 and 2015 in a total of 364 wells across the Santa Clara and Llagas subbasins. These maximum depth to water values were interpolated in GIS to create a map, as shown in Figure 5. The interpolation method was used to create a basin wide coverage because water level measurements are only available at certain locations through Valley Water's water level monitoring program and data obtained from water retailers. Because Figure 5 represents an interpolated surface of the maximum depth to water from the monitoring network wells during 2014 and 2015, it contains inherent uncertainty, including potential errors between the interpolated depth to water values and actual water level measurements if they had been available in 2014 and 2015. The uncertainties of the interpolated depth to water are likely greater near the basin boundaries where there are relatively fewer measured water level readings to serve as control points.

Figure 5. Maximum Depth to Water in the Groundwater Management Areas during the Drought Peak (2014–2015).

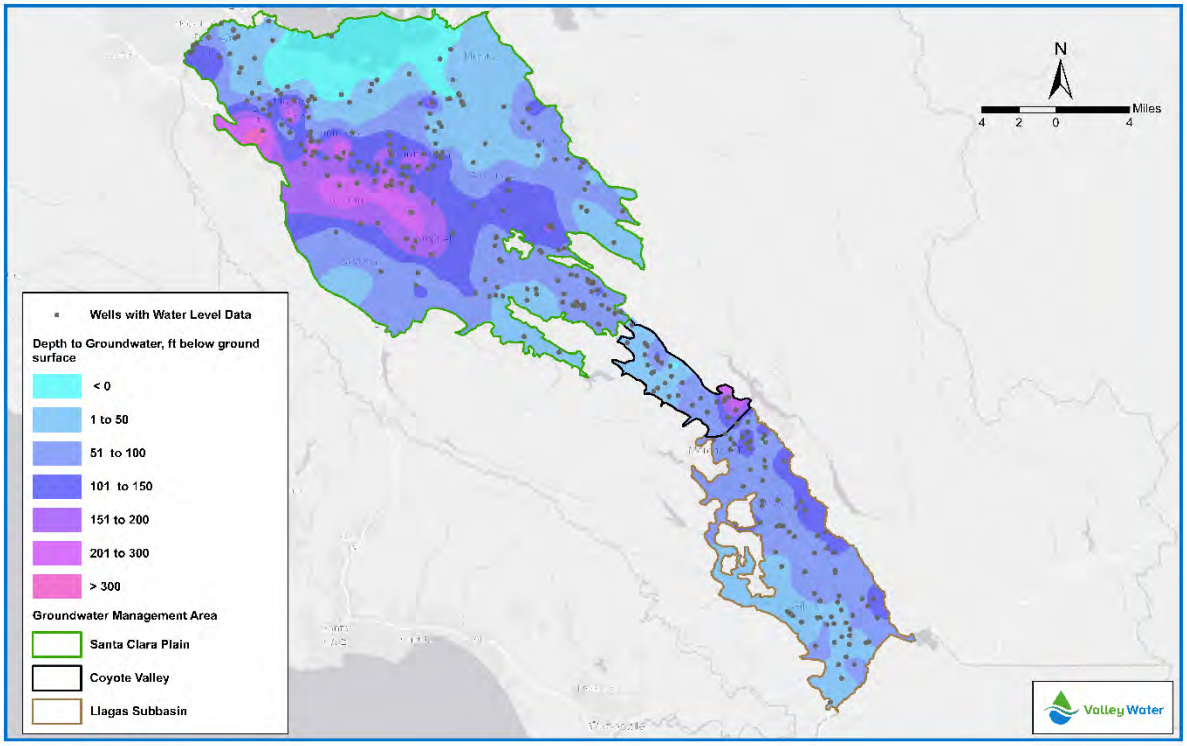


Figure 5 indicates that the maximum depth to water was greatest in parts of the west-central areas of the Santa Clara Plain groundwater management area, southeastern corner of the Coyote Valley groundwater management area, and along the eastern edge of the Llagas Subbasin. The negative ("<0") values in Figure 5 indicate artesian conditions of the principal aquifer, which are primarily located in the northern and central areas of the Santa Clara Plain.

2.3. Reported Dry Domestic Wells During the 2012–2016 Drought

During the 2012–2016 drought, only 0.23% (14 of the 5,969) of the active and standby water supply wells in the Santa Clara and Llagas subbasins were reported by well owners to Valley Water as having gone dry (Figure 6). All were domestic wells, including ten wells in the North County and 4 wells in the South County. The 14 dry wells were located near the subbasin boundaries, with eight inside the subbasin boundaries, and six nearby, but outside the subbasins.

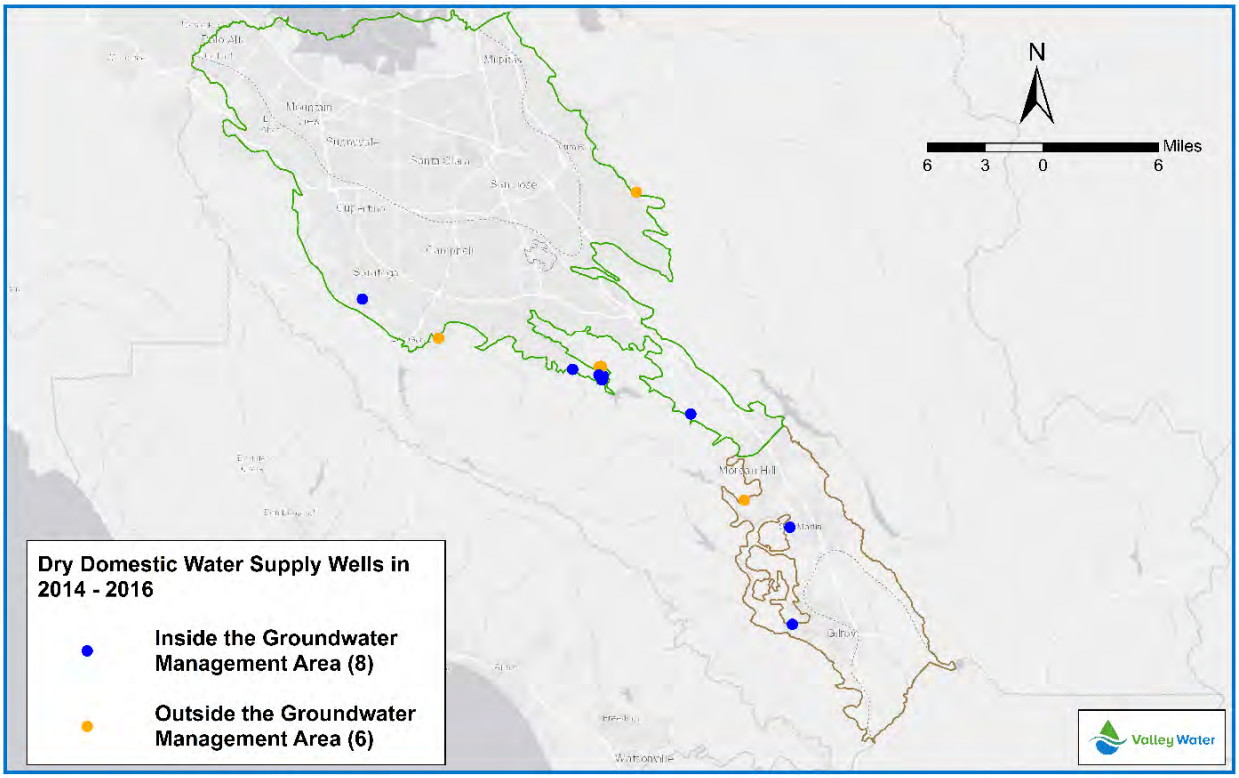
The eight dry wells (Figure 6) within the subbasin boundaries represent only 1.4% (6 of 415) and 0.16% (2 of 1,242) of active or standby domestic or agricultural wells with well depth information in the Santa Clara and Llagas subbasins, respectively (Table 5). Only one of the dry domestic wells in the Santa Clara Subbasin is located in the Coyote Valley groundwater management area (Figure 6). All eight wells are located along the margin of the subbasins where groundwater storage is relatively lower and water levels are more responsive to pumping stresses. This is because of the boundary effects with lower permeability geologic units, which have the cumulative effect of relatively greater declines in water levels in those wells.

Table 5. Active or Standby Domestic or Agricultural Wells with Completed Depth Information in the Groundwater Management Areas.

Well Use Type	Santa Clara Subbasin		Llagas Subbasin	Total
	Santa Clara Plain	Coyote Valley		
Agricultural	29	31	157	217
Domestic	226	129	1,085	1,440
Total	255	160	1,242	1,657

Only five of the 14 reported dry domestic wells have available well construction information. For those five wells, the completed well depths range from 30 to 400 feet below land surface (bls). The deepest of the dry wells are located in the foothills along the western edge of the Santa Clara Plain, which has some of the largest depth to water in the groundwater management areas (Figure 6).

Figure 6. Domestic Supply Wells Reported Dry during the Recent Drought (2012–2016) Compared to Groundwater Management Areas.



3. Potential Vulnerability of Water Supply Wells to Drought

This section describes the analysis performed using the interpolated groundwater surface, available well depth information, and statistical analysis to assess the vulnerability of water supply wells to drought.

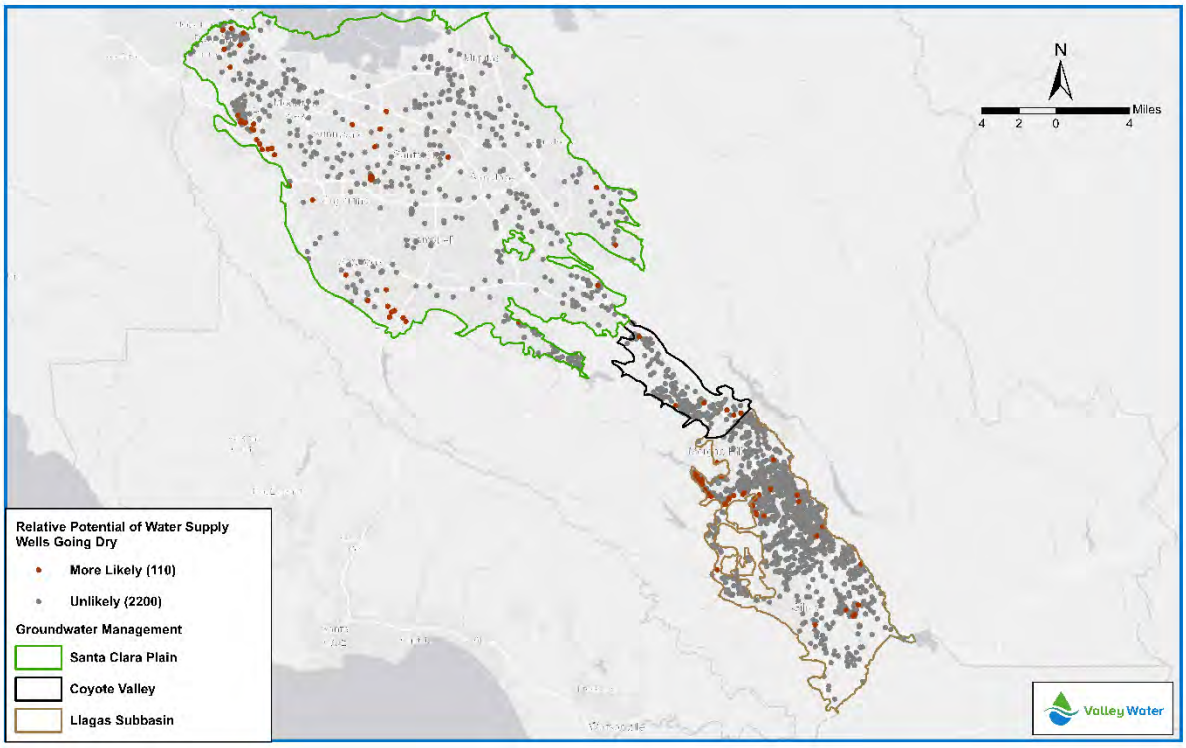
3.1. Relative Vulnerability of Water Supply Wells Based on Well Depth

To evaluate the potential vulnerability of water supply wells to drought, Valley Water compared the interpolated depth to groundwater map based on 2014/2015 conditions (Figure 5) with available well depth information. Wells with total depth less than the interpolated groundwater surface were assumed to be more vulnerable to going dry (Figure 7). This analysis indicates the vast majority of wells (95%) were not likely vulnerable to going dry, even during the peak drought conditions of 2014-2015. However, 110 wells (representing 4.8% of the 2,303 supply wells with completed well depth information) were identified as more vulnerable. This estimate includes about 9% (59 of 675) of supply wells in the Santa Clara Plain, 3% (6 of 198) in the Coyote Valley (southern Santa Clara Subbasin), and 3% (45 of 1,427) in the Llagas Subbasin. However, it is worth noting that none of the 14 wells actually reported as going dry (Figure 6) were identified using this method. This can be attributed to the previously described uncertainties associated with the maximum depth to water interpolation and well construction information.

Comparing the number of reported dry wells (14) to the estimated number of vulnerable wells (110) suggests the latter is overestimated by an order of magnitude. However, the location of these wells is somewhat similar to the location of actual reported dry wells (Figure 6), which includes areas along the western boundary of the Santa Clara Plain, southeastern corner of Coyote Valley, and along the boundary

of the Llagas Subbasin. Unlike water retailer wells which are generally located in the subbasin interior and serve large populations, supply wells along the subbasin margins are generally privately owned domestic wells with small volumes of pumping (generally less than 1 acre-foot per year). Wells within the center of the basins shown as vulnerable are likely shallower, and/or are located in areas with large depth to water in 2014/2015.

Figure 7. Relative Vulnerability of Wells to Drought Based on Well Depth.

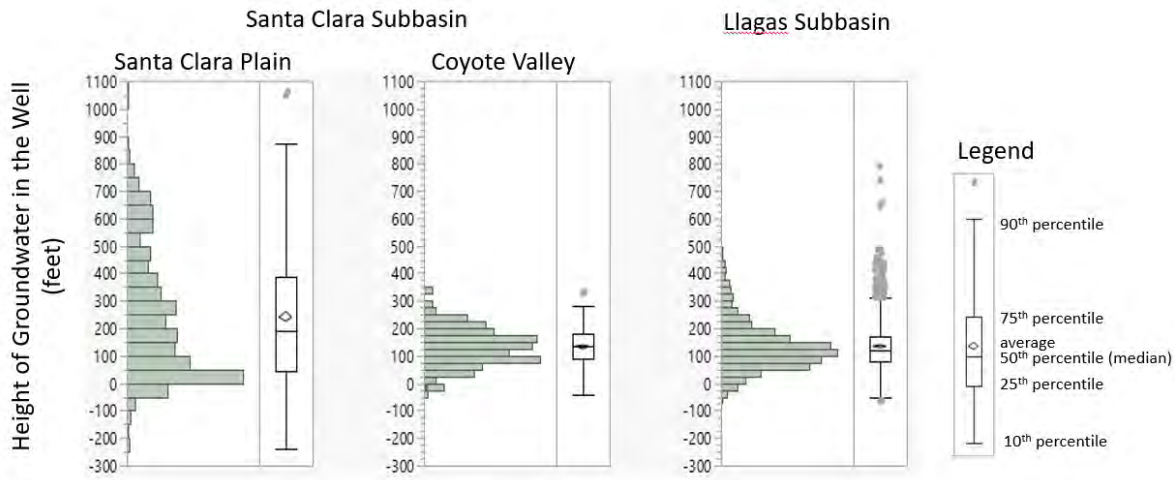


Note: Analysis based on wells with total depth less than interpolated depth to groundwater surface for 2014/2015. Uncertainty with interpolated surface and well construction information indicates more vulnerable wells (110) compared to actual reports of dry wells (14).

3.2. Distribution of Water Supply Well Depth Relative to Maximum Depth to Water

This section further evaluates the question of how many water supply wells may have been at risk of going dry during the 2012–2016 drought. Rather than relying on relative ranking, this evaluation relies on the statistical distribution of how far the interpolated water level surface was above the bottom of each well during the 2014–2015 drought peak, referred to here as the "height of groundwater". Negative values indicate that the well depth is below the interpolated groundwater surface (indicating vulnerability to going dry) and positive values indicate the height of groundwater remaining in each well. This analysis was applied to all the supply wells in the groundwater management areas with well depth information (Table 4). The results are shown in Figure 8 as both a statistical distribution and boxplot for each of the three groundwater management areas.

Figure 8. Statistical Distribution of Remaining Height of Groundwater in Supply Wells during the 2014–2015 Drought Peak by Groundwater Management Area.



Note – Height of groundwater is calculated for supply wells with total well depth information available as the difference between the completed well depth and the interpolated groundwater surface from 2014–2015.

Figure 8 supports the prior conclusion that most water supply wells likely had a substantial height of groundwater above the completed well depth and were not vulnerable to going dry during the 2012–2016 drought. The positive height of groundwater in the Santa Clara Plain wells ranged from 1 to 1,100 ft, which is consistent with the deeper principal aquifer system and confined conditions in that groundwater management area. The height of groundwater in supply wells in the Coyote Valley and Llagas Subbasin were comparatively smaller, ranging from more than 4 to 350 ft and more than 7 to 800 ft, respectively.

The estimated height of groundwater remaining in domestic and agricultural wells during the 2014–2015 drought peak is shown in Figure 9. Nearly all domestic and agricultural wells had a substantial height of groundwater above the completed well depth during the 2012–2016 drought (Figure 10).

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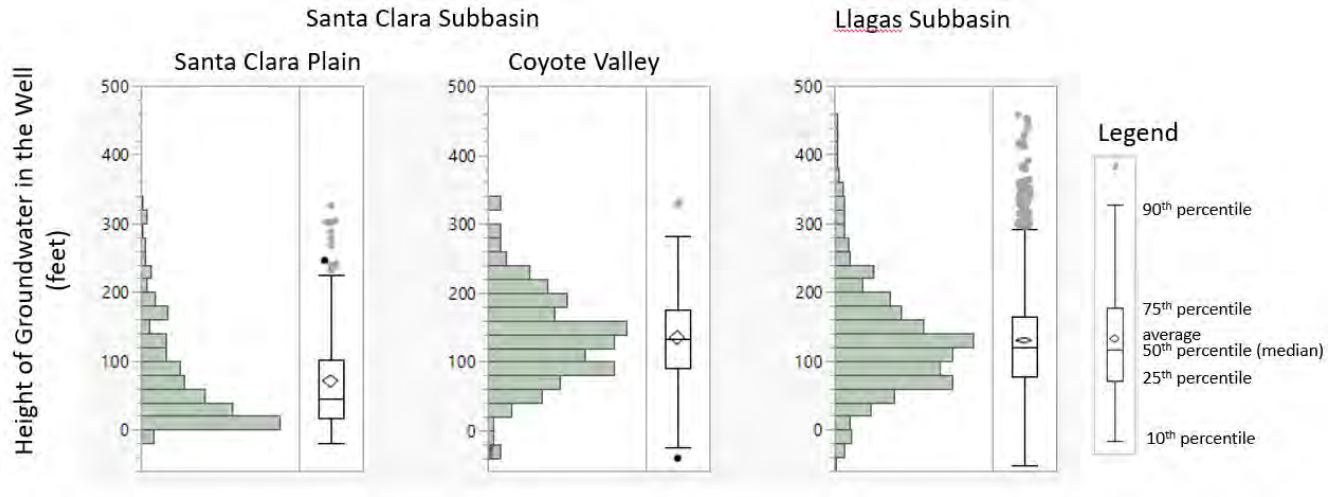
Figure 9. Statistical Distribution of Remaining Height of Groundwater in Domestic and Agricultural Wells during the 2014–2015 Drought Peak by Groundwater Management Area.



Note – Height of groundwater is calculated for supply wells with total well depth information available as the difference between the completed well depth and the interpolated groundwater surface from 2014–2015.

The distributions in Figures 8 and 9 indicate that the Santa Clara Plain may have had a relatively greater number of supply wells with interpolated water levels closer to 0 feet (i.e., potential dry well conditions) as compared to the Coyote Valley and Llagas Subbasin. This difference is likely attributed to the fact that many domestic wells in the Santa Clara Plain are located in the foothills on the western edge of the management area where there is a relatively large depth to water (Figure 5). In comparison, many of the domestic and agricultural wells in the Coyote Valley and Llagas Subbasins are in the valley floor where water levels are closer to land surface and groundwater storage is relatively greater. The results presented in Figure 9 support the finding that the majority of domestic and agricultural wells were not likely vulnerable to going dry during the 2014–2015 drought peak.

4. Summary and Conclusions

This memo documents the number of dry domestic wells that were reported by well owners to Valley Water during the 2012–2016 drought. Only 0.23% (14 of 5,969) of the total active and standby water supply wells in the Santa Clara and Llagas subbasins were reported dry during that drought, specifically between 2014 and 2016. Of those 14, all are domestic wells located near the margin of the subbasins where groundwater storage is relatively low compared to the interior of the subbasin. The relatively small percentage of reported dry supply wells and their locations indicates that Valley Water's management practices are maintaining sustainable groundwater conditions, even during drought.

Although not reported dry by well owners, other domestic and agricultural wells may have been vulnerable to going dry during the 2012–2016 drought. Using an interpolated surface of the maximum depth to water during the peak of the drought in 2014-2015, an additional 110 supply wells with available completed well depth may have been vulnerable, including about 60 supply wells in the Santa Clara Plain, 6 wells in the Coyote Valley, and 45 wells in the Llagas Subbasin. An analysis of the statistical distributions of completed well depths indicates that the Santa Clara Plain may have had a relatively larger percentage of supply wells at risk of going dry compared to the Coyote Valley or Llagas Subbasin. Similar to the actual

reported dry domestic wells, these additional 110 supply wells that may have been vulnerable are also primarily located along the margin of the subbasins.

While informative in terms of potential risks to water supply wells during drought, the analysis described in this memo includes significant inherent uncertainty due to regional interpolation and limited data points. In particular, Valley Water has few water level monitoring wells near the basin margins, where wells are most likely at risk of going dry. Information on completed well depths is also available for fewer than 40% of supply wells, so simplifying assumptions are also made in this analysis. Interestingly, the wells actually reported as dry during the 2012–2016 drought were not identified as being vulnerable in this analysis, highlighting the challenge of using simplified approaches and interpolation over large regions. This analysis helps Valley Water to evaluate potential areas and wells at risk, but likely overestimates vulnerable supply wells due to inherent uncertainty associated with the methods used. Valley Water will explore alternative analytical approaches to better understand potential supply well impacts from drought.

The findings from this memo are being incorporated into the gap analysis of Valley Water's groundwater level monitoring program that is being conducted as part of the 2021 GWMP update. Several of the areas with either reported or estimated dry domestic and agricultural wells, especially along the western areas of the Santa Clara Plain, coincide with identified gaps in the groundwater level monitoring program. Filling such gaps in the water level monitoring program are likely to provide data that will result in a better understanding of groundwater conditions and vulnerability of water supply wells to drought. Additionally, the data and findings from this memo will be included in Valley Water's adaptive groundwater management strategy, which includes learning and adapting to new data sets with the goal of maintaining continued sustainable groundwater conditions in the Santa Clara and Llagas subbasins.

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Appendix E – 2019 Annual Groundwater Report

2019 Annual Groundwater Report

Valley Water

July 2020

Annual Groundwater Report 2019

Santa Clara Valley Water District

Annual Groundwater Report for Calendar Year 2019

Prepared by:
George Cook, P.G.
Senior Water Resources Specialist

Jason Gurdak, Ph.D., P.H.
Senior Water Resources Specialist

Victoria Garcia
Associate Water Resources Specialist

Under the Direction of:
Vanessa De La Piedra, P.E.
Groundwater Management Unit Manager

Aaron Baker, P.E.
Deputy Operating Officer
Raw Water Division

Contributors:
Chanie Abuye
Randy Behrens
Michael Bunij
Keila Cisneros
Scott Elkins
Ardy Ghoreishi
Simon Gutierrez
Jeannine Larabee
Yaping Liu
Travis Moore
Roger Pierno
Colton Short
Xiaoyong Zhan

Graphic Design:
Joan Ang
Krishna Cruz
Jimin Lee

Reprographics:
Hector Fuentes

TABLE OF CONTENTS

LIST OF FIGURES **4**

LIST OF TABLES **5**

LIST OF APPENDICES **6**

EXECUTIVE SUMMARY **7**

CHAPTER 1 – INTRODUCTION **13**

CHAPTER 2 – GROUNDWATER PUMPING, RECHARGE, AND WATER BALANCE **17**

2.1 Groundwater Pumping 17
2.2 Groundwater Recharge 26
2.3 Groundwater Balance 29

CHAPTER 3 – GROUNDWATER LEVELS AND STORAGE **33**

3.1 Groundwater Levels 33
3.2 Groundwater Storage 39

CHAPTER 4 – LAND SUBSIDENCE **41**

4.1 Extensometer Monitoring 41
4.2 Benchmark Elevation Surveys 42
4.3 Subsidence Index Wells 42

CHAPTER 5 – GROUNDWATER QUALITY **49**

5.1 Regional Groundwater Quality 50
5.2 Groundwater Quality Trends 55
5.3 Domestic Well Water Quality 64
5.4 Recharge Water Quality 68
5.5 Monitoring Near Recycled Water Irrigation Sites 71
5.6 Salt and Nutrient Management Plans 78
5.7 Contaminant Release Sites 79
5.8 Well Ordinance Program 80

CHAPTER 6 – GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION **83**

6.1 Outcome Measure Performance and Action Plan 83
6.2 Status of Groundwater Management Plan Recommendations 84
6.3 Status of Sustainable Groundwater Management Act Compliance 88

LIST OF FIGURES

Figure 1. Santa Clara and Llagas Subbasins 15
Figure 2. Groundwater Benefit Zones and Local Cities 16
Figure 3. CY 2019 Zone W-2 Groundwater Pumping 19
Figure 4. CY 2019 Zone W-5 Groundwater Pumping 20
Figure 5. Countywide Groundwater Pumping and Managed Recharge 22
Figure 6. Countywide Water Use 23
Figure 7. Groundwater Pumping by Use Category 24
Figure 8. Percent of Total Pumping by Major Groundwater Users in 2019 25
Figure 9. Countywide Groundwater Pumping and Recharge in CY 2019 26
Figure 10. Valley Water Managed Recharge Facilities 27
Figure 11. Managed Recharge by Source - North County and South County 28
Figure 12. CY 2019 Groundwater Balance 31
Figure 13. CY 2019 Groundwater Level Monitoring 35
Figure 14. Groundwater Elevations at Regional Index Wells 36
Figure 15. Spring 2019 Groundwater Elevation Contours in the Principal Aquifers 37
Figure 16. Fall 2019 Groundwater Elevation Contours in the Principal Aquifers 38
Figure 17. Land Subsidence Monitoring Network 43
Figure 18. Cumulative Compaction at Extensometers 44
Figure 19. Average Annual Change of Land Surface Elevation between 2009 and 2019 45
Figure 20. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88) 46
Figure 21. CY 2019 Groundwater Quality Monitoring Wells 51
Figure 22. Median Nitrate and TDS by Subbasin and Aquifer Zone (mg/L) 52
Figure 23. CY 2019 MCL Exceedances at Water Supply Wells 54
Figure 24. Chloride Concentration Trends (2005 - 2019) 58
Figure 25. Nitrate Concentration Trends (2005 - 2019) 59
Figure 26. Total Dissolved Solids (TDS) Concentration Trends (2005 - 2019) 60
Figure 27. Boxplots Representing Fifteen-year Step Trend Groups 62
Figure 28. Groundwater and Salt Water Interaction in the Santa Clara Plain Shallow Aquifer 64
Figure 29. Nitrate Results for Domestic Wells Tested in 2019 66
Figure 30. Location of 2019 Sampling Sites in the Coyote, Los Gatos, and West Side Recharge Systems 70
Figure 31. Groundwater Monitoring Near Santa Clara Subbasin Recycled Water Irrigation Sites 75
Figure 32. Groundwater Monitoring Near Llagas Subbasin Recycled Water Irrigation Sites 78

LIST OF TABLES

Table ES-1. CY 2019 Groundwater Supply Conditions Compared to Other Years 9
Table ES-2. CY 2019 Groundwater Quality Conditions Compared to Other Years 10
Table ES-3. Summary of 2019 Outcome Measure Performance and Action Plan 11
Table 1. CY 2019 Groundwater Pumping by Use (AF) 17
Table 2. Number of Wells Reporting Groundwater Use in CY 2019 18
Table 3. CY 2019 Groundwater Pumping Compared to Other Periods (AF) 21
Table 4. CY 2019 Managed Recharge (AF) 27
Table 5. Groundwater Elevations at Regional Index Wells (feet, NGVD88) 34
Table 6. Estimated End of Year Groundwater Storage (AF) 39
Table 7. Chloride, Nitrate, and TDS Concentration Trends (2005 – 2019) 57
Table 8. Total Dissolved Solids, Nitrate, and Chloride Step Trend Outcome in Principal Aquifers 61
Table 9. 2019 Domestic Well Testing Results 67
Table 10. 2019 Recharge Water Quality Sampling Locations 69
Table 11. Summary of Key Water Quality Indicators for All Recharge Systems Sampled in 2019 71
Table 12. Summary of 2019 Groundwater Monitoring Events near Recycled Water Irrigation Sites 73
Table 13. Groundwater Concentration Trends at Santa Clara Plain Recycled Water Irrigation Sites 74
Table 14. Groundwater Concentration Trends at Llagas Subbasin Recycled Water Irrigation Sites 77
Table 15. Comparison of 2019 Median Concentrations with Projected 2019 SNMP Median Concentrations 79
Table 16. CY 2019 Valley Water Well Permit and Inspection Summary 80
Table 17. Summary of Outcome Measure Performance 83

LIST OF APPENDICES

APPENDIX A – 2019 Subsidence Data Analysis

APPENDIX B – Annual Groundwater Quality Summary Report

APPENDIX C – 2019 Groundwater Quality Results

APPENDIX D – 2019 Recharge Water Quality Results

APPENDIX E – 2019 Water Quality Evaluation at Recycled Water Irrigation Sites

APPENDIX F – Water Year 2019 Report for the Santa Clara and Llagas Subbasins (Submitted to the California Department of Water Resources in April 2020)

EXECUTIVE SUMMARY

The Santa Clara Valley Water District (Valley Water) is the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas Subbasins[1] in Santa Clara County, which are sustainably managed through the comprehensive activities described in Valley Water's 2016 Groundwater Management Plan (GWMP).[2] This Annual Groundwater Report for Calendar Year (CY) 2019 is separate from and more comprehensive than the annual report required under the Sustainable Groundwater Management Act (SGMA). This report describes groundwater use, levels, quality, storage, and land subsidence and presents the status of GWMP outcome measures using recent data. These measures identified in the GWMP are used to evaluate performance relative to Valley Water Board of Directors (Board) Water Supply Objective 2.1.1: "Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion."

Groundwater pumping by water retailers and other well users was 110,400 acre-feet (AF)[3], providing 37% of the total water used in the county in 2019. To help sustain and protect groundwater supplies, in 2019 Valley Water:

- Recharged groundwater with 83,500 AF of local and imported surface water,
- Reduced groundwater demands by 195,000 AF through treated surface water and recycled water deliveries and water conservation programs, which collectively provide in-lieu groundwater recharge,
- Conducted extensive monitoring and analysis of groundwater levels and quality, and land subsidence,
- Implemented the well ordinance program and other activities to minimize threats to groundwater quality, and
- Worked with basin stakeholders, land use agencies, and regulatory agencies to protect groundwater resources.

Table ES-1 shows data for key indicators in 2019 as compared to 2018 and prior periods. Having previously fully recovered from the 2012-2016 drought, groundwater levels and storage continued their rise, with an estimated 15,200 AF[4] added to groundwater storage in 2019 since recharge exceeded pumping and other outflows. Groundwater levels in 2019 remained near historical highs in regional index wells and at many other wells around the county. Estimated end of 2019 total groundwater storage was 356,700 AF, which falls well within the normal stage (Stage 1) of Valley Water's Water Shortage Contingency Plan, indicating good water supply conditions.

Groundwater quality remained generally good in principal aquifer zones; median values for Total Dissolved Solids (TDS) were at or below 410 milligrams per liter (mg/L) in all groundwater management areas (Appendix C). Principal aquifer median nitrate values were at or below 4.7 mg/L in all three management areas, below the drinking water standard of 10 mg/L. However, because elevated nitrate persists in individual wells, Valley Water continues to work with regulatory and land use agencies to address this ongoing groundwater protection challenge.

North County Groundwater Summary

Groundwater use in the Santa Clara Plain (the northern Santa Clara Subbasin) was 57,700 AF in 2019, a 9% decrease from 2018. This is below the long-term average of 95,000 AF due to continued lower demand and

[1] California Department of Water Resources (DWR) Basins 2-9.02 and 3-3.01, respectively. Valley Water further divides the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.
[2] Santa Clara Valley Water District, Groundwater Management Plan, November 2016. This plan was submitted to DWR as an Alternative to a Groundwater Sustainability Plan in December 2016 and approved for SGMA compliance in July 2019.
[3] All values presented in this report are based on best available data (measured or estimated) and may be refined as additional data becomes available.
[4] Groundwater storage estimates presented in this report are as of March 2020 and represent accumulated storage as described further in Chapter 3. Storage estimates are updated as additional data becomes available.

increased use of treated surface water by water retailers. Pumping locations and uses remained relatively stable, with nearly all (99%) groundwater used for municipal and industrial (M&I) purposes.

Groundwater levels remained fully recovered from the 2012-2016 drought, with water levels in many wells at or above historical highs. Groundwater levels are also well above the minimum water level thresholds established to protect against land subsidence. Land subsidence data for 2019 indicates uplift, reflecting healthy groundwater conditions. Estimated groundwater storage at the end of 2019 was 315,700 AF, which was 6,300 AF higher than 2018.

North County groundwater continues to have very good quality overall. In 2019, 99% of water supply wells tested met all health-based drinking water standards. Public water systems must comply with drinking water standards, which may require treatment or blending prior to delivery.

South County Groundwater Summary

In 2019, groundwater pumping in the Coyote Valley (the southern Santa Clara Subbasin) and Llagas Subbasin was 11,100 AF and 41,600 AF, respectively. Pumping decreased by 8% in the Coyote Valley and by 4% in the Llagas Subbasin compared to 2018. Most pumping in the Coyote Valley was for M&I uses (72%), with smaller amounts for agricultural (26%) and domestic (2%) uses. In the Llagas Subbasin, 56% of total pumping was for agriculture, 40% for M&I use and less than 4% for private domestic use. Estimated groundwater storage in South County (Coyote Valley and Llagas Subbasin) at the end of 2019 was 41,000 AF, which is 8,900 AF higher than 2018. Groundwater levels remained healthy and were well above historical lows at regional index wells.

Groundwater quality in South County is generally good, with most water supply wells meeting drinking water standards. However, nitrate continues to be a significant groundwater quality challenge; it was detected above the drinking water standard in 23% of South County water supply wells tested in 2019 (primarily domestic wells). As described in the outcome measure summary below, Valley Water continues to work to address this challenge.

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Table ES-1. CY 2019 Groundwater Supply Conditions Compared to Other Years

Index – Groundwater Supply	2019	Compared to 2018	Compared to 5-Year Average (2015 - 2019)
Total Managed Recharge (AF)	83,500	Down 17%	Down 13%
Total Groundwater Pumping (AF)	110,400	Down 7%	Down 4%
Groundwater as % of Total Water Use	37%	Down 3%	Down 1%
Groundwater Elevations (feet, NGVD88)[1]			
Santa Clara Plain	90.7	Down 1.9 feet	Up 13.2 feet
Coyote Valley	277.2	Up 4.6 feet	Up 5.4 feet
Llagas Subbasin	229.0	Up 5.4 feet	Up 12.9 feet
End of Year Groundwater Storage (AF)	356,700	Up 4%	Up 14%
Land Subsidence (feet/year)[2]	-0.006 (Uplift)	No Change (Uplift)	No Change (Uplift)

Notes:

1. Groundwater elevations are shown for three groundwater management areas: the Santa Clara Plain and Coyote Valley (which comprise the Santa Clara Subbasin) and the Llagas Subbasin. Groundwater elevations represent the average of all readings at three regional groundwater level index wells for the time period noted based on the National Geodetic Vertical Datum of 1988.
2. Valley Water calculates subsidence using the average measured subsidence at two extensometers over the most recent 11-year period. Measured compaction is below the established tolerable rate of 0.01 feet/year, and throughout 2019, water levels at all ten subsidence index wells were above related thresholds established to prevent permanent subsidence.

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Table ES-2. CY 2019 Groundwater Quality Conditions Compared to Other Years

Index – Groundwater Quality[1]	2019 Median[2]	5-Year Step Trend[3]	10-Year Step Trend	15-Year Step Trend
Total Dissolved Solids in Principal Aquifers (TDS, mg/L)				
Santa Clara Plain	410	No Change	No Change	No Change
Coyote Valley	384	No Change	No Change	No Change
Llagas Subbasin	404	No Change	No Change	No Change
Nitrate in Principal Aquifers (as Nitrogen, mg/L)				
Santa Clara Plain	3.1	No Change	No Change	No Change
Coyote Valley	4.2	No Change	No Change	No Change
Llagas Subbasin	4.7	No Change	No Change	No Change

Notes:

1. Groundwater quality indices are shown for three groundwater management areas: the Santa Clara Plain and Coyote Valley (which comprise the Santa Clara Subbasin) and the Llagas Subbasin.
2. Values represent the median groundwater concentration for principal aquifer zone wells tested (both water supply wells and monitoring wells).
3. The median 2019 concentration for each groundwater management area was compared to that of 5 years ago (2014), 10 years ago (2009), and 15 years ago (2004) to determine if there is any statistically significant difference using the Mann-Whitney test at the 95% confidence level.

Outcome Measure Summary

The GWMP identifies outcome measures to assess performance relative to Board policy and groundwater sustainability goals. The status of these measures using 2019 data is shown in Table ES-2 below, along with actions to address measures not being met. All outcome measures related to groundwater storage, levels, and land subsidence were met in 2019. Continued sustainable groundwater supply conditions demonstrate the effectiveness of significant investments in basin management facilities, diverse water supplies, and conjunctive water management, as well as close coordination with water retailers.

Elevated nitrate continues to be the primary groundwater protection challenge in South County, where a significant number of domestic wells contain water with nitrate above the drinking water standard. Valley Water continues to coordinate with land use and regulatory agencies to influence related policies, regulations, and decisions. More directly, Valley Water's managed recharge programs help dilute nitrate, and water quality testing and treatment system rebates help to reduce well owner exposure. While most wells have stable or decreasing long-term chloride concentrations, increasing concentrations in some shallow aquifer wells warrant further evaluation.

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Table ES-3. Summary of 2019 Outcome Measure Performance and Action Plan

Groundwater Storage	**OM 2.1.1.a.** Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain. **Outcome measure met:** End of 2019 groundwater storage is 315,700 AF.
	OM 2.1.1.b. Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley. **Outcome measure met:** End of 2019 groundwater storage is 12,800 AF.
	OM 2.1.1.c. Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin. **Outcome measure met:** End of 2019 groundwater storage is 28,200 AF.
Groundwater Levels and Subsidence	**OM 2.1.1.d.** 100% of subsidence index wells with groundwater levels above subsidence thresholds. **Outcome measure met:** All ten wells had groundwater levels above thresholds in 2019.
Groundwater Quality	**OM 2.1.1.e.** At least 95% of countywide water supply wells meet primary drinking water standards. **Measure not met:** Only 87% of water supply wells tested in 2019 had water that met primary drinking water standards due to elevated nitrate, mainly in South County domestic wells. If nitrate is not included, 100% of water supply wells met primary drinking water standards. **OM 2.1.1.f.** At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives. **Measure met:** All wells (100%) had water that met agricultural objectives.
	Action Plan for OM 2.1.1.e: Implement Salt and Nutrient Management Plans to address nitrate, continue free domestic well testing and nitrate treatment system rebate programs, and continue collaborating with regulatory and land use agencies to address nitrate loading.
Groundwater Quality Trends	**OM 2.1.1.g.** At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids. **Measure partially met:** This measure is not met for chloride, with 82% of wells having water with stable or decreasing concentration trends. The measure is met for nitrate and total dissolved solids, with stable or decreasing concentrations observed in 91% and 94% of wells, respectively.
	Action Plan for OM 2.1.1.g: Implement Salt and Nutrient Management Plans to address salt loading, continue collaborating with regulatory and land use agencies.

Status of Sustainable Groundwater Management Act (SGMA) Compliance

In July 2019, DWR released their assessment of fifteen Alternatives to a Groundwater Sustainability Plan (GSP) submitted for SGMA compliance by Valley Water and other agencies. DWR approved Valley Water's GWMP for the Santa Clara and Llagas Subbasins, finding it satisfies the objectives of SGMA. The next five-year update of the GWMP must be submitted to DWR by January 2022. Valley Water has submitted three annual reports for these subbasins as required by SGMA, with the most recent submittal (April 2020) included as an appendix to this report.

As the GSA for the small portions of the North San Benito Subbasin[5] in Santa Clara County, Valley Water is supporting San Benito County Water District efforts to develop a GSP for the entire subbasin.

[5] This subbasin is primarily located in San Benito County, where the San Benito County Water District (SBCWD) is the GSA. In 2019, DWR approved a basin boundary modification creating the North San Benito Subbasin through consolidation of several subbasins. The subbasins consolidated into the North San Benito Subbasin include the former Hollister and San Juan Bautista subbasins, which extend into Santa Clara County.

Groundwater Management Plan Implementation

To maintain sustainable groundwater conditions, Valley Water continues to implement the proactive groundwater management activities described in the GWMP. Chapter 6 of this report summarizes the status of the six major GWMP recommendations. Notable progress includes continued investment in high-priority capital projects (including dam safety and purified recycled water), the decision to participate in the California WaterFix[6], and coordination with water retailers and other stakeholders to develop a process to regulate groundwater extraction under SGMA, if needed.

Continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion," in accordance with Board policy.

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[6] The project name and scope changed in 2019. The project is now known as the Delta Conveyance Project and focuses on a single tunnel per direction from Governor Newsom.

CHAPTER 1 – INTRODUCTION

The Santa Clara Valley Water District (Valley Water) has the responsibility and authority to manage the Santa Clara and Llagas groundwater subbasins in Santa Clara County per the California legislature.[7] Valley Water also formally became the Groundwater Sustainability Agency (GSA) for these subbasins in 2016. Valley Water's comprehensive groundwater management activities and investments, described in the 2016 Groundwater Management Plan (GWMP)[8], have resulted in sustainable groundwater conditions for many decades. Valley Water's groundwater management objectives and authority under the Santa Clara Valley Water District Act (District Act) are to recharge groundwater basins, conserve, manage and store water for beneficial and useful purposes, increase water supply, protect surface water and groundwater from contamination, prevent waste or diminution of the water supply, and do any and every lawful act necessary to ensure sufficient water is available for present and future beneficial uses.

Valley Water Board of Directors (Board) Water Supply Objective 2.1.1 reflects the mission to protect groundwater resources: ***"Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion."*** Pursuant to the District Act and Board policy, Valley Water identifies the following basin management objectives in the GWMP[9]:

- Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.
- Groundwater is protected from existing and potential contamination, including salt water intrusion.

Purpose

This annual report describes groundwater conditions in the Santa Clara and Llagas Subbasins for Calendar Year (CY) 2019 including groundwater use, recharge, water levels, water balance, storage, quality, and land subsidence. The following outcome measures (OM) derived from the GWMP are also assessed to evaluate performance in meeting Water Supply Objective 2.1.1:

- OM 2.1.1.a Greater than 278,000 AF[10] of projected end of year groundwater storage in the Santa Clara Plain.[11]
- OM 2.1.1.b Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley.
- OM 2.1.1.c Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin.
- OM 2.1.1.d 100% of Santa Clara Plain subsidence index wells with groundwater levels above subsidence thresholds.
- OM 2.1.1.e At least 95% of countywide water supply wells meet primary drinking water standards.
- OM 2.1.1.f At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives.
- OM 2.1.1.g At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.

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[7] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.
[8] Santa Clara Valley Water District, Groundwater Management Plan, November 2016.
[9] Valley Water submitted this plan to the California Department of Water Resources as an Alternative to a Groundwater Sustainability Plan for Sustainable Groundwater Management Act compliance. The plan was approved in July 2019.
[10] AF = acre-feet. One acre-foot is equal to 325,851 gallons.
[11] As described subsequently, Valley Water divides the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.

The Santa Clara and Llagas Subbasins, located in Santa Clara County, are identified by the California Department of Water Resources (DWR) as Basin 2-9.02 and Basin 3-3.01, respectively (Figure 1). Valley Water divides the Santa Clara Subbasin into two groundwater management areas, the Santa Clara Plain and the Coyote Valley, due to different land use and management characteristics. The Santa Clara and Llagas Subbasins are separated by a groundwater divide near Cochrane Road in Morgan Hill. Groundwater in the Santa Clara Subbasin generally flows toward San Francisco Bay, while flow in the Llagas Subbasin is generally to the southeast toward the Pajaro River. The Santa Clara Plain and Llagas Subbasin have both confined and recharge areas. Within the confined areas, low permeability clays and silts separate shallow and principal aquifers, with the latter defined as aquifer materials greater than 150 feet below ground surface. The recharge areas are unconfined as there are no laterally extensive aquitards forming distinct shallow and principal aquifer zones.

The information in this report is summarized by groundwater management area or by groundwater charge zone (Figure 2). Groundwater charge zones, or groundwater benefit zones, are areas where Valley Water collects fees from groundwater users based on the benefits received from Valley Water groundwater management activities. Zone W-2 (North County) generally coincides with the Santa Clara Plain, while Zone W-5 (South County) generally overlaps the combined area of the Coyote Valley and Llagas Subbasin.[12]

Report Content

In addition to this Introduction, this Annual Groundwater Report for 2019 includes the following chapters:

- Chapter 2: Groundwater Pumping, Recharge, and Water Balance
- Chapter 3: Groundwater Levels and Storage
- Chapter 4: Land Subsidence
- Chapter 5: Groundwater Quality
- Chapter 6: Other Groundwater Management Activities

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[12] In April 2020, the Valley Water Board of Directors approved changes to the groundwater benefit zones that included modifications to the boundary of Zone W-2 and a partitioning of Zone W-5 into three zones effective July 1, 2020. The two zones in effect prior to July 1, 2020 are used in this report.

Figure 1. Santa Clara and Llagas Subbasins

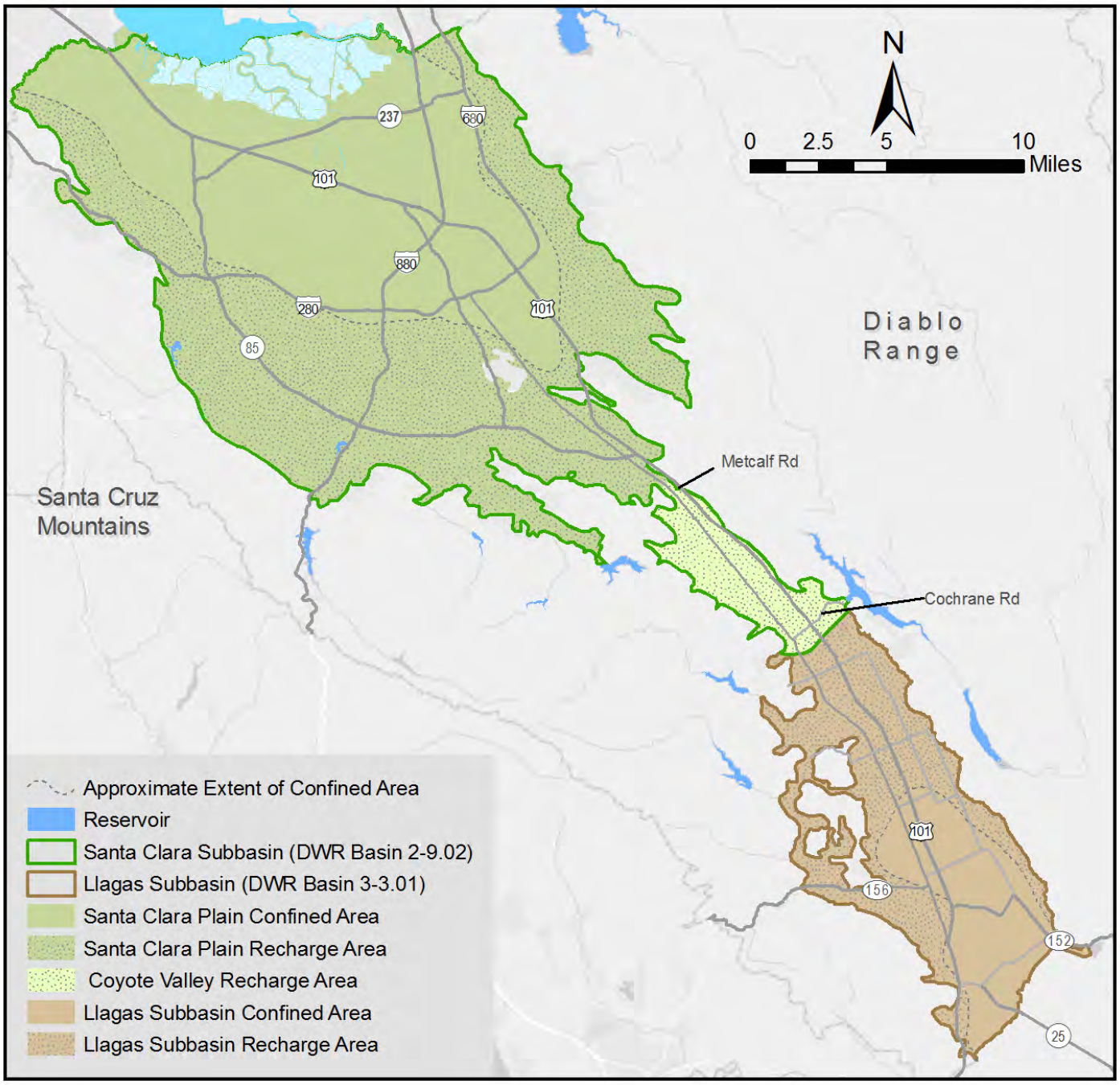
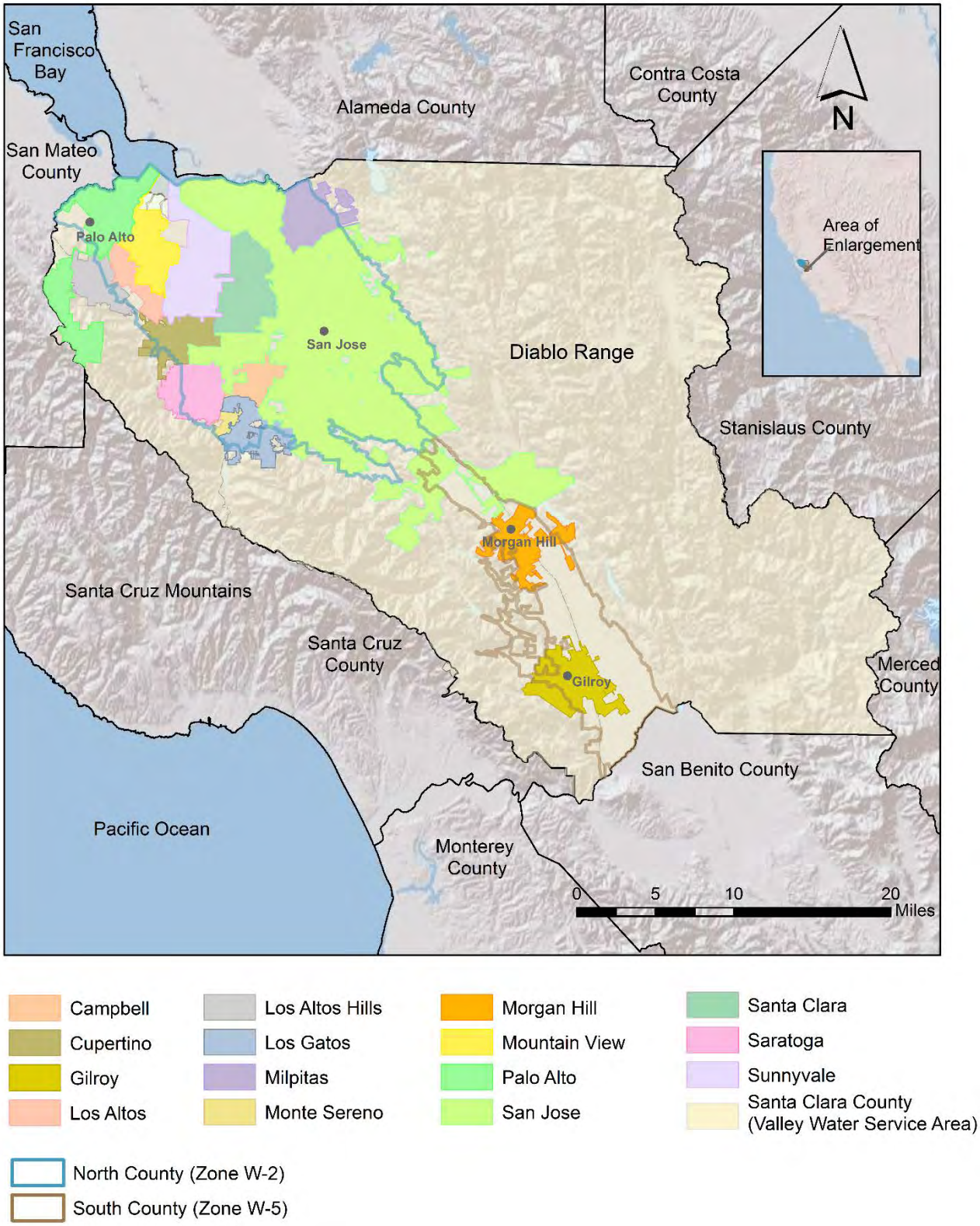


Figure 2. Groundwater Benefit Zones and Local Cities



CHAPTER 2 – GROUNDWATER PUMPING, RECHARGE, AND WATER BALANCE

Total groundwater pumping for 2019 in Zones W-2 and W-5 was 110,400 AF, providing 37% of the total water used[13] by county residents and businesses. Compared to 2018, groundwater pumping decreased 9% in the Santa Clara Plain, 8% in the Coyote Valley, and 3% in the Llagas Subbasin in 2019. Valley Water used about 83,500 AF of local and imported surface water to replenish the groundwater subbasins as managed recharge. In-lieu recharge, including treated and recycled water deliveries and water conservation programs, reduced demands on groundwater by approximately 195,000 AF.

Managed recharge provided about 57% of the total inflow to the subbasins and groundwater pumping accounted for over 84% of outflows. Due to good water supply conditions, the inflows exceeded the outflows, resulting in a net increase in countywide groundwater storage of 15,200 AF from 2018 to 2019.

2.1 Groundwater Pumping

Approximately 110,400 AF of groundwater was pumped in 2019, compared to 118,300 AF in 2018. Figures 3 and 4 show the locations and volumes of groundwater pumping and Table 1 summarizes the pumping by groundwater management area and use category.

Groundwater in North County is used primarily for Municipal and Industrial (M&I) purposes, with minimal agricultural or domestic use. In South County, agricultural use is more significant. This is especially evident in the Llagas Subbasin, where 56% of the use is for agriculture. While the quantity of groundwater used for domestic purposes is relatively small in South County, 74% of the 3,917 individual wells reporting using groundwater in South County were domestic wells (Table 2).

Table 1. CY 2019 Groundwater Pumping by Use (AF)

Use	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
Municipal & Industrial (M&I)	57,000	8,000	16,700	81,700
Domestic	200	200	1,700	2,100
Agricultural	500	2,900	23,200	26,600
Total	**57,700**	**11,100**	**41,600**	**110,400**

Note: Large volume pumpers are metered and report groundwater production to Valley Water monthly. Pumping for wells reporting semi-annually or annually (primarily domestic and agricultural) was estimated based on available data and/or prior year data as validated data was not available by the date of publication of this report.

[13] Total water use in the county was 296,000 AF and it came from groundwater pumping (37.3%), Valley Water treated water deliveries (34.4%), San Francisco Public Utilities Commission supplies to local retailers (16.6%), recycled water deliveries (5.8%), raw surface water deliveries (0.3%), and San Jose Water Company and Stanford water rights (5.5%). This total does not reflect groundwater pumping in bedrock areas outside Zones W-2 and W-5; these areas are sparsely populated compared to the valley floor, with presumed low water use.

Table 2. Number of Wells Reporting Groundwater Use in CY 2019

Use	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
Municipal & Industrial (M&I)	719	72	289	1,080
Domestic	310	347	2,534	3,191
Agricultural	42	95	580	717
Total	**1,071**	**514**	**3,403**	**4,988**

Note: Some wells may report pumping for more than one use category (e.g., domestic and agricultural). The number of wells reporting semi-annually or annually (primarily domestic and agricultural) was estimated based on prior year as validated data was not available by the date of publication of this report.

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Figure 3. CY 2019 Zone W-2 Groundwater Pumping

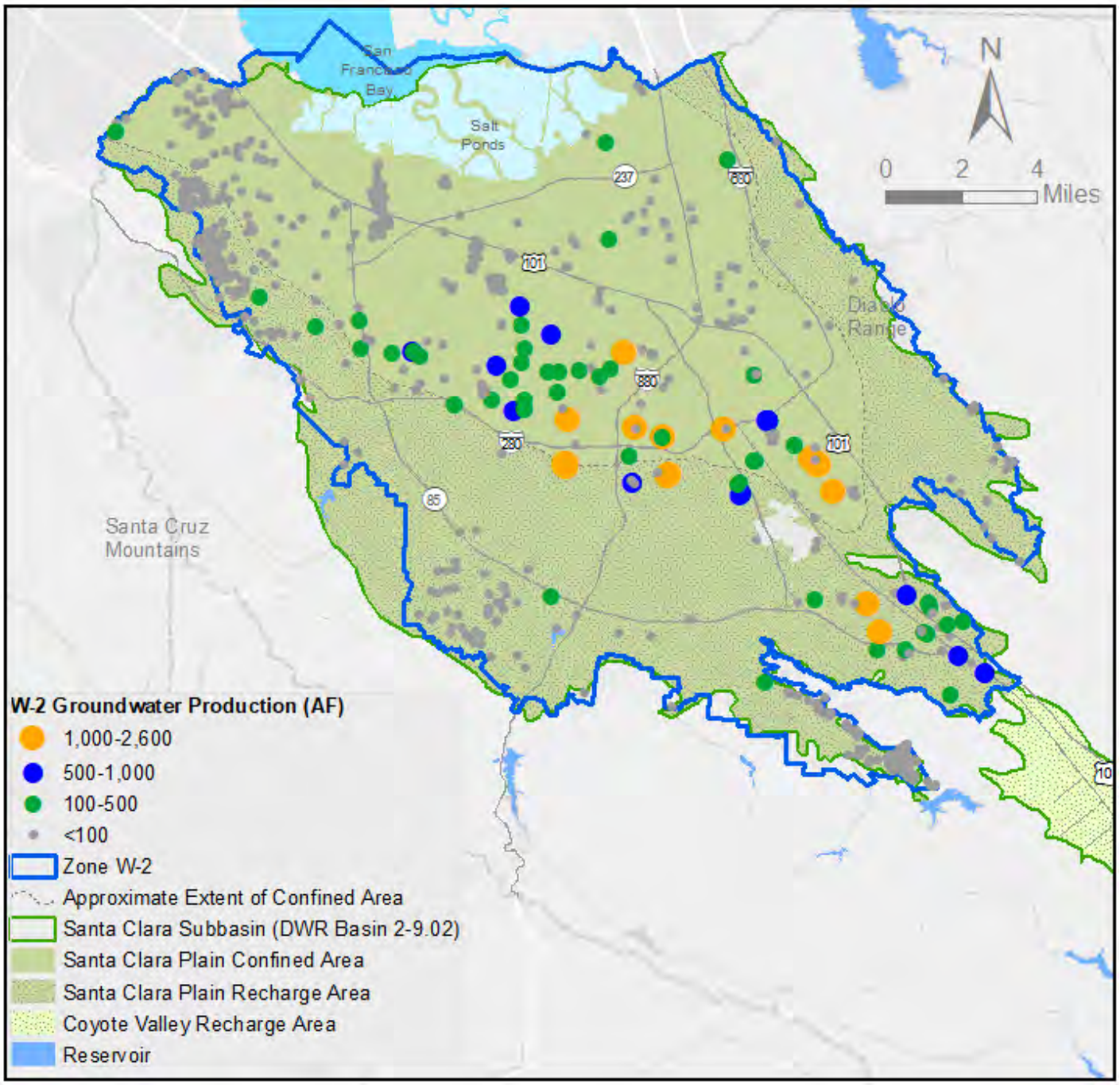
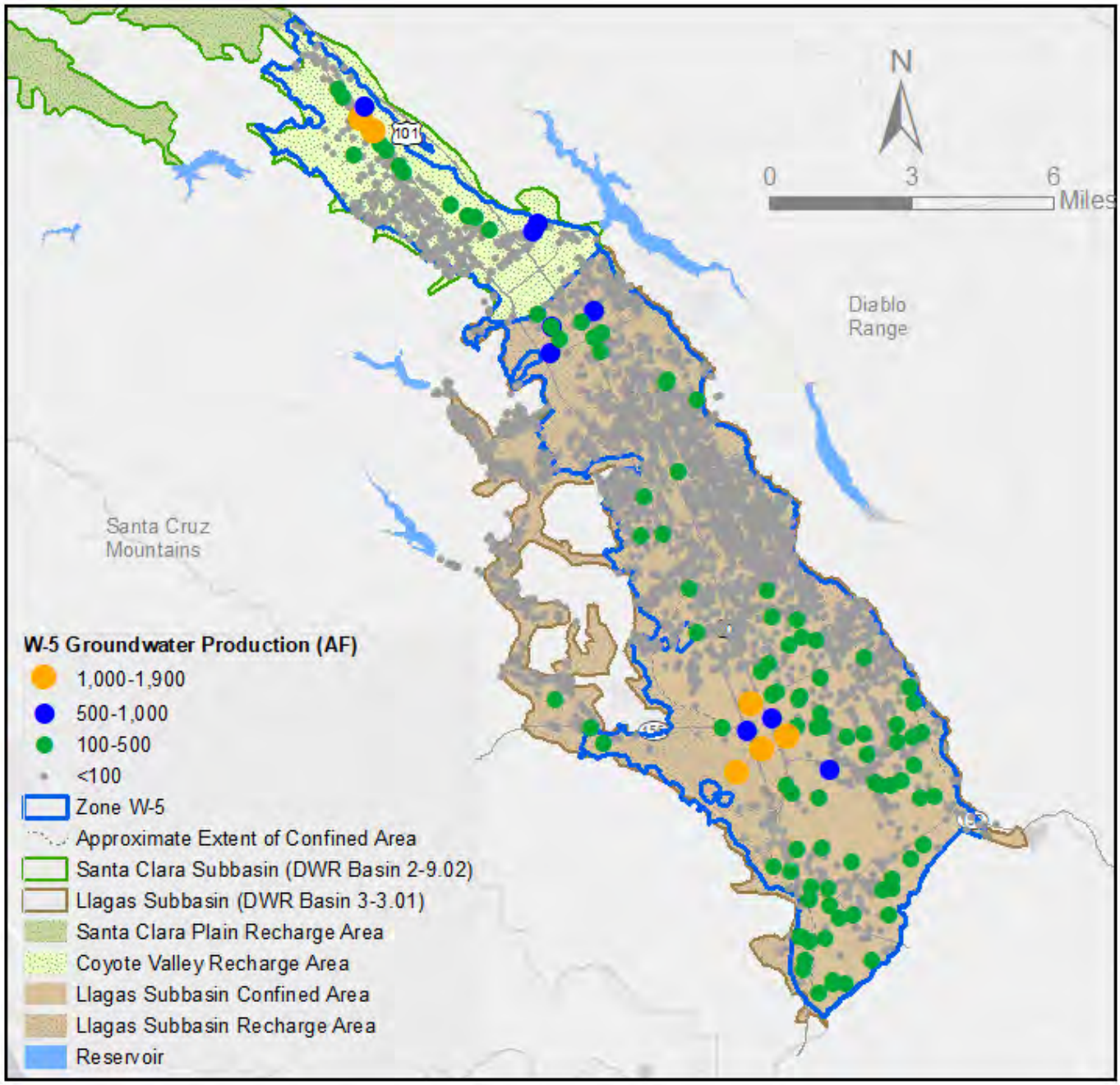


Figure 4. CY 2019 Zone W-5 Groundwater Pumping



Groundwater Pumping Trends

Countywide, estimated total water use was 296,000 AF in 2019, slightly less than 2018 (297,000 AF). Countywide groundwater pumping was down 7% from the previous year, below the recent five-year average, and below the average over the period of record. This is largely driven by low pumping in the Santa Clara Plain and Coyote Valley (Table 3). Compared to last year, groundwater pumping decreased 9% in the Santa Clara Plain, 8% in the Coyote Valley, and 3% in the Llagas Subbasin. Groundwater pumping is largely offset by Valley Water's managed recharge of local and imported surface water (Figure 5). Managed recharge typically averages about two thirds of the pumping, with natural recharge balancing the remaining pumping. Figure 6 shows the countywide water use by source, including groundwater, Valley Water treated water, San Francisco Public Utility Commission (SFPUC) supplies, local surface water, and recycled water. Groundwater provided 37% of the total water used countywide in 2019.

Groundwater pumping and use patterns over time are shown in Figure 7 for each of the groundwater management areas. In the Santa Clara Plain, pumping dropped significantly in the late 1980s following completion of Valley Water's Santa Teresa Water Treatment Plant (WTP). Since then, pumping has averaged 95,000 AF per year. Pumping spiked in the middle of the recent drought to 115,000 AF in 2014; however, the water retailers and community responded to the Valley Water Board's calls for water use reduction, and pumping decreased significantly during the past five years, averaging about 62,500 AF per year. A notable increase in pumping in the Coyote Valley occurred in 2006 when a water retailer installed new wells and began extracting water to serve customers in the Santa Clara Plain. This increased the average annual pumping volume by about 4,000 AF in Coyote Valley as reflected in Table 3. Pumping in the Llagas Subbasin has remained relatively stable over the period of record.

Table 3. CY 2019 Groundwater Pumping Compared to Other Periods (AF)

Period	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
2019	57,700	11,100	41,600	110,400
2018	63,400	12,000	42,900	118,300
5 Year Average (2015-2019)	62,500	11,200	41,400	115,100
Period of Record (Average)	106,500	7,400	40,500	154,400

Note: The period of record is 1981-2019 for the Santa Clara Plain and 1988-2019 for the Coyote Valley and Llagas Subbasin.

Major Groundwater Users

The largest groundwater users in each zone are shown in Figure 8. Water retailers are the primary users in North County, accounting for over 89% of all pumping in 2019. San Jose Water Company is the largest individual user, accounting for 57% of total North County pumping, followed by other retailers and a few large industrial users. Unlike North County, 53% of pumping in South County was from thousands of individual pumpers including agricultural and domestic users. In South County, pumping by water retailers and water companies accounted for 39% of groundwater use. Other large users include golf courses and industrial facilities.

Figure 5. Countywide Groundwater Pumping and Managed Recharge

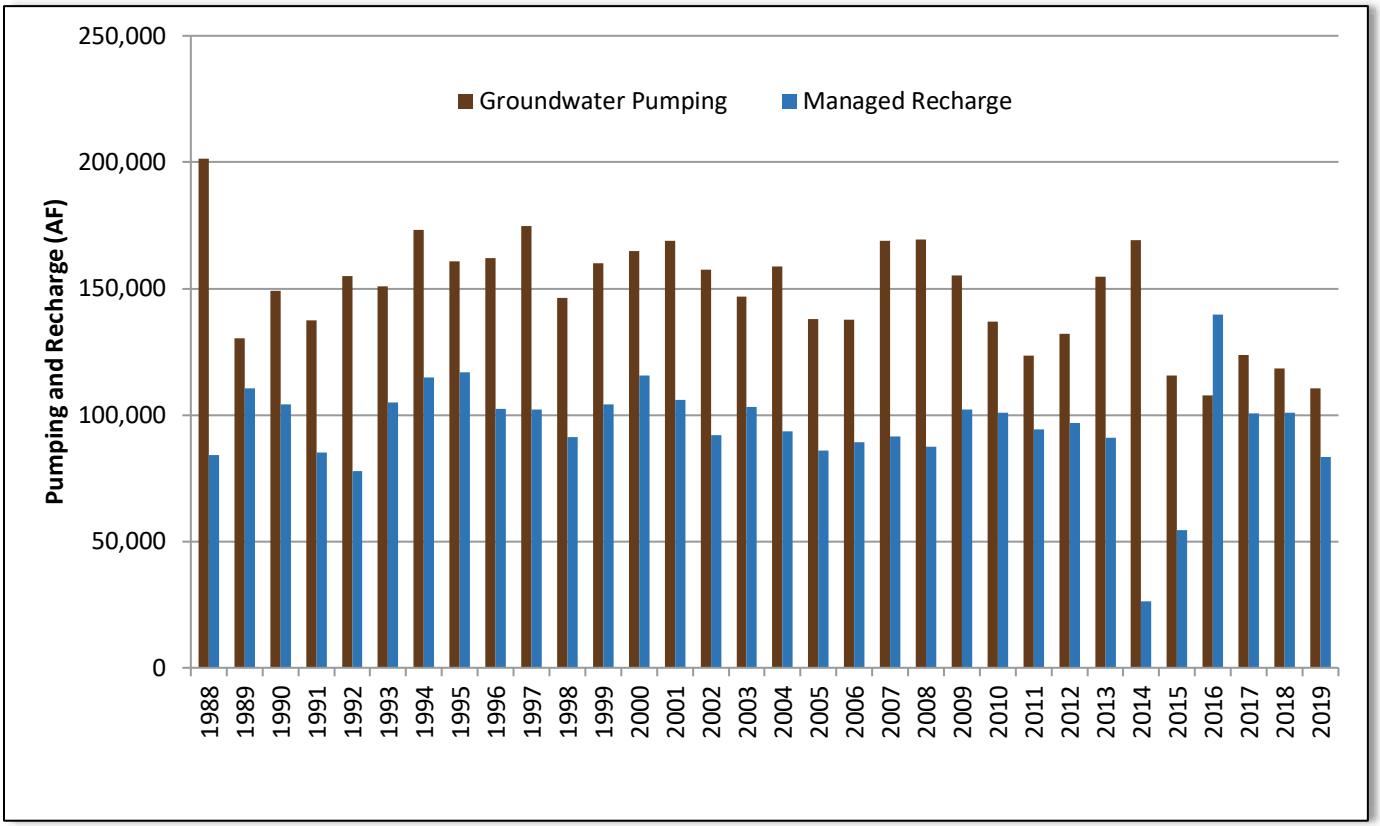


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Figure 6. Countywide Water Use

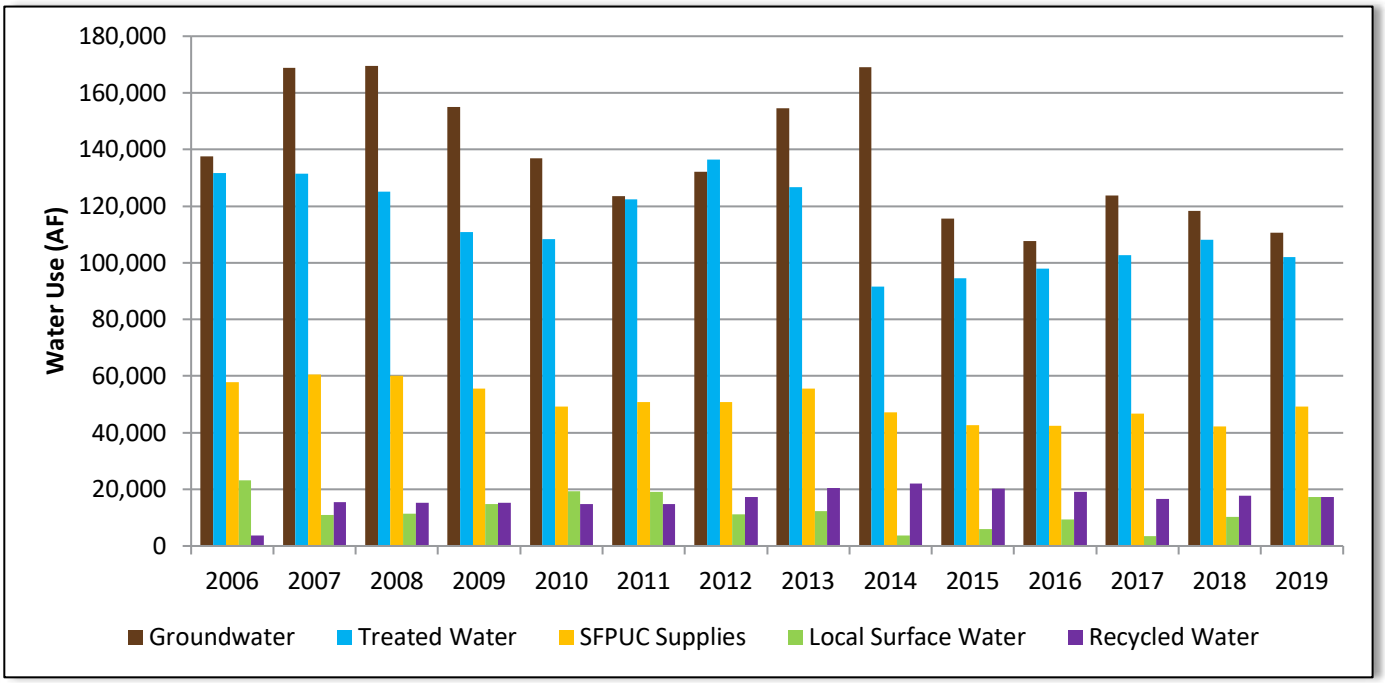

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Figure 7. Groundwater Pumping by Use Category

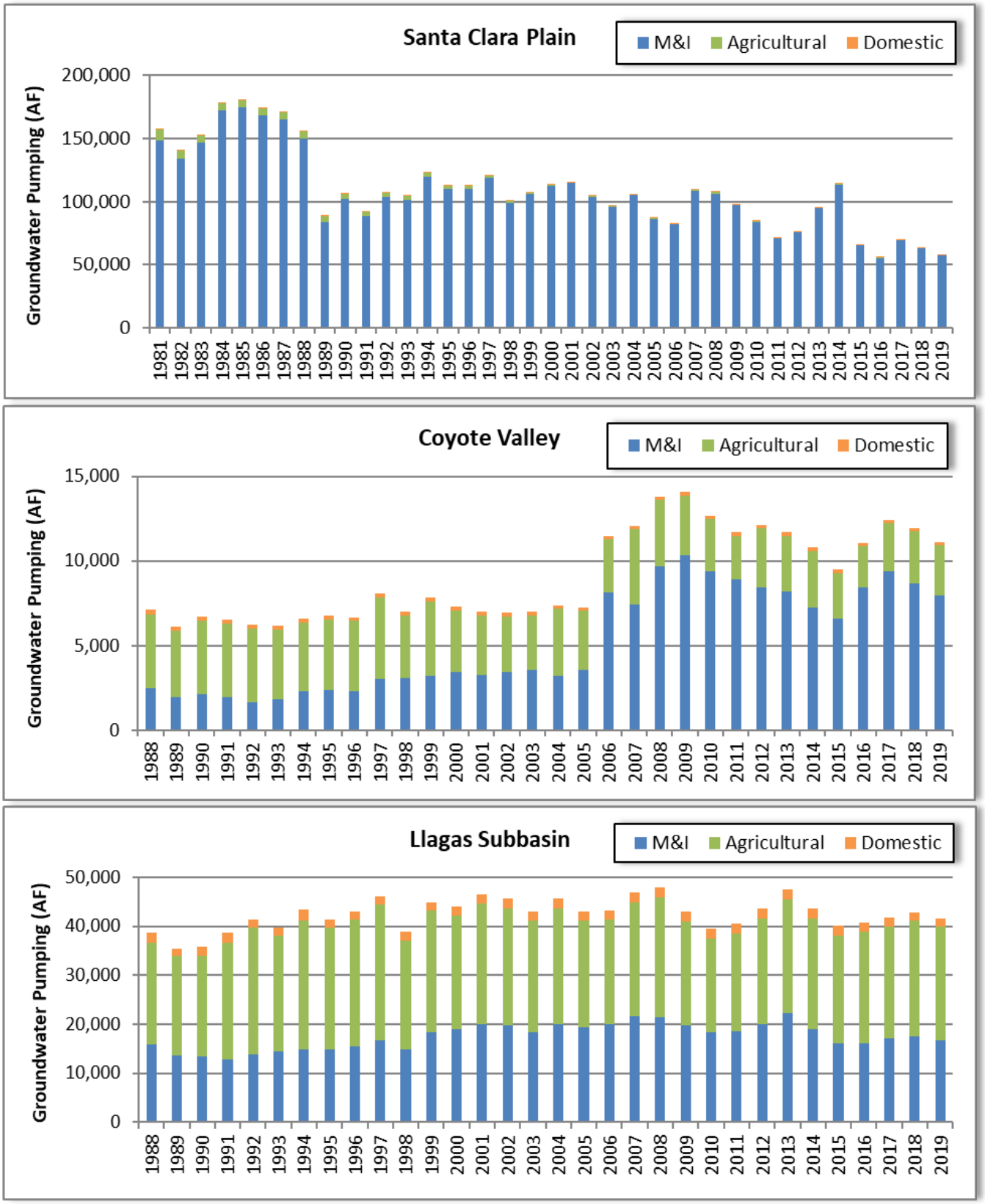
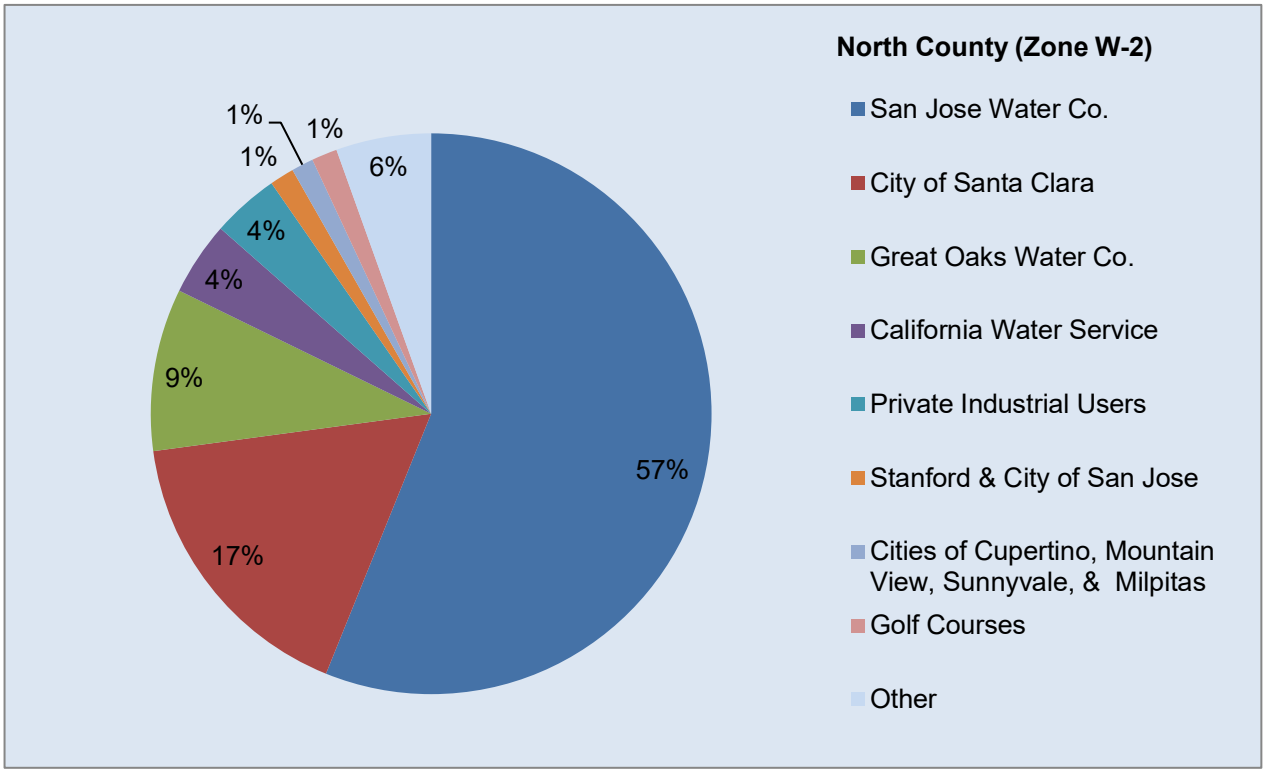
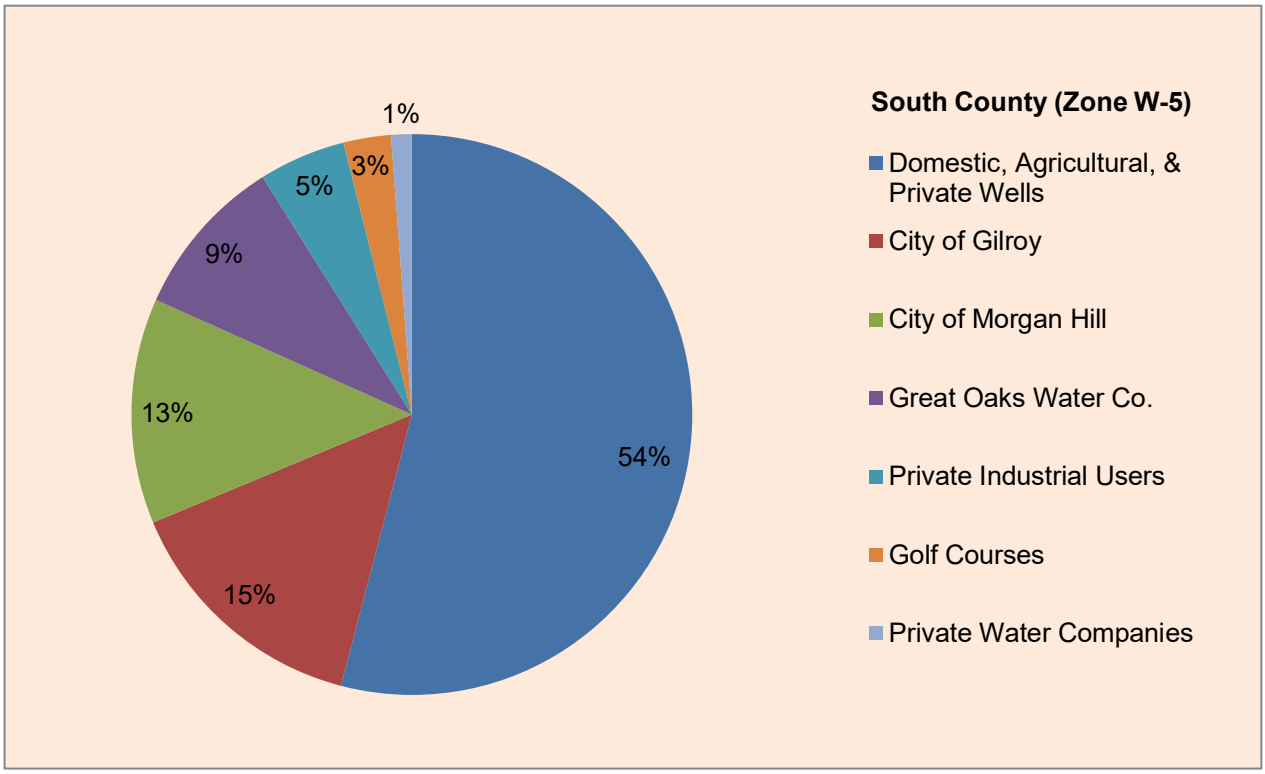


Figure 8. Percent of Total Pumping by Major Groundwater Users in 2019

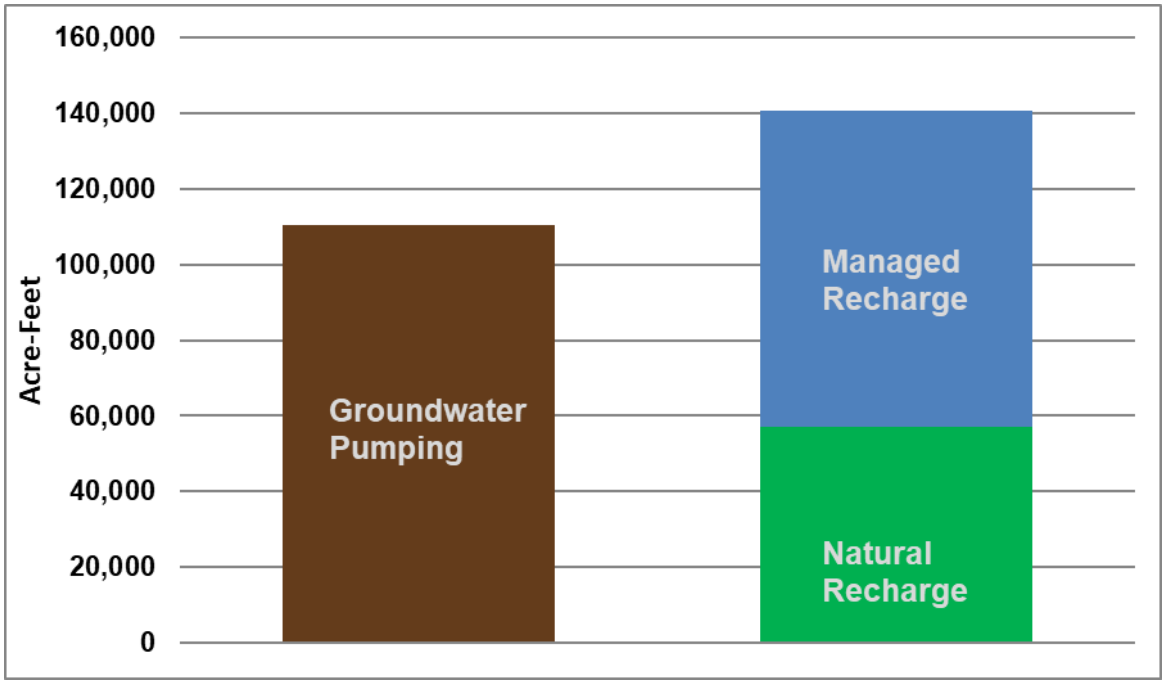




2.2 Groundwater Recharge

Since the 1930s, Valley Water's water supply strategy has been to maximize the conjunctive management of surface water and groundwater. Annual groundwater pumping far exceeds what is replenished naturally, so Valley Water ensures water supply reliability with its managed recharge and in-lieu recharge activities. Total recharge exceeded groundwater pumping in 2019 (Figure 9) by a larger than normal margin due to below average pumping, above average rainfall, and the availability of surface water to fully operate the managed recharge program.

Figure 9. Countywide Groundwater Pumping and Recharge in CY 2019



Managed Recharge

Valley Water replenishes groundwater with imported water and surface runoff captured in 10 local reservoirs. Recharge facilities include more than 300 acres of recharge ponds and over 90 miles of creeks (Figure 10). Imported sources include the Federal Central Valley Project (CVP) and the State Water Project (SWP). The relative amounts of imported or local water used for managed recharge each year depend on many factors including hydrology, imported water allocations, treatment plant demands, and environmental needs. In general, a greater percentage of local water is used for recharge in wet years due to increased capture of local storm runoff in local reservoirs. Valley Water recharged 83,500 AF of local and imported surface water in 2019 (Table 4), below the long-term average of 95,000 AF. In North County, Valley Water operated a reduced managed recharge program, leaving many percolations ponds dry due to healthy groundwater conditions (including very strong artesian pressures near the bay) and continued low pumping. Countywide, most of the managed recharge (80%) occurred in-stream, with the remainder through percolation ponds. Most water used for managed recharge came from local sources (82% in North County and 74% in South County). Overall, imported water contributed 22% to total managed recharge in CY 2019, as shown in Figure 11.

Table 4. CY 2019 Managed Recharge (AF)

Zone	In-Stream Recharge (Creeks)	Off-Stream Recharge (Recharge Ponds)	Total
W-2 (North County)	29,600	12,400	42,000
W-5 (South County)	36,900	4,600	41,500
Total	66,500	17,000	83,500

Figure 10. Valley Water Managed Recharge Facilities

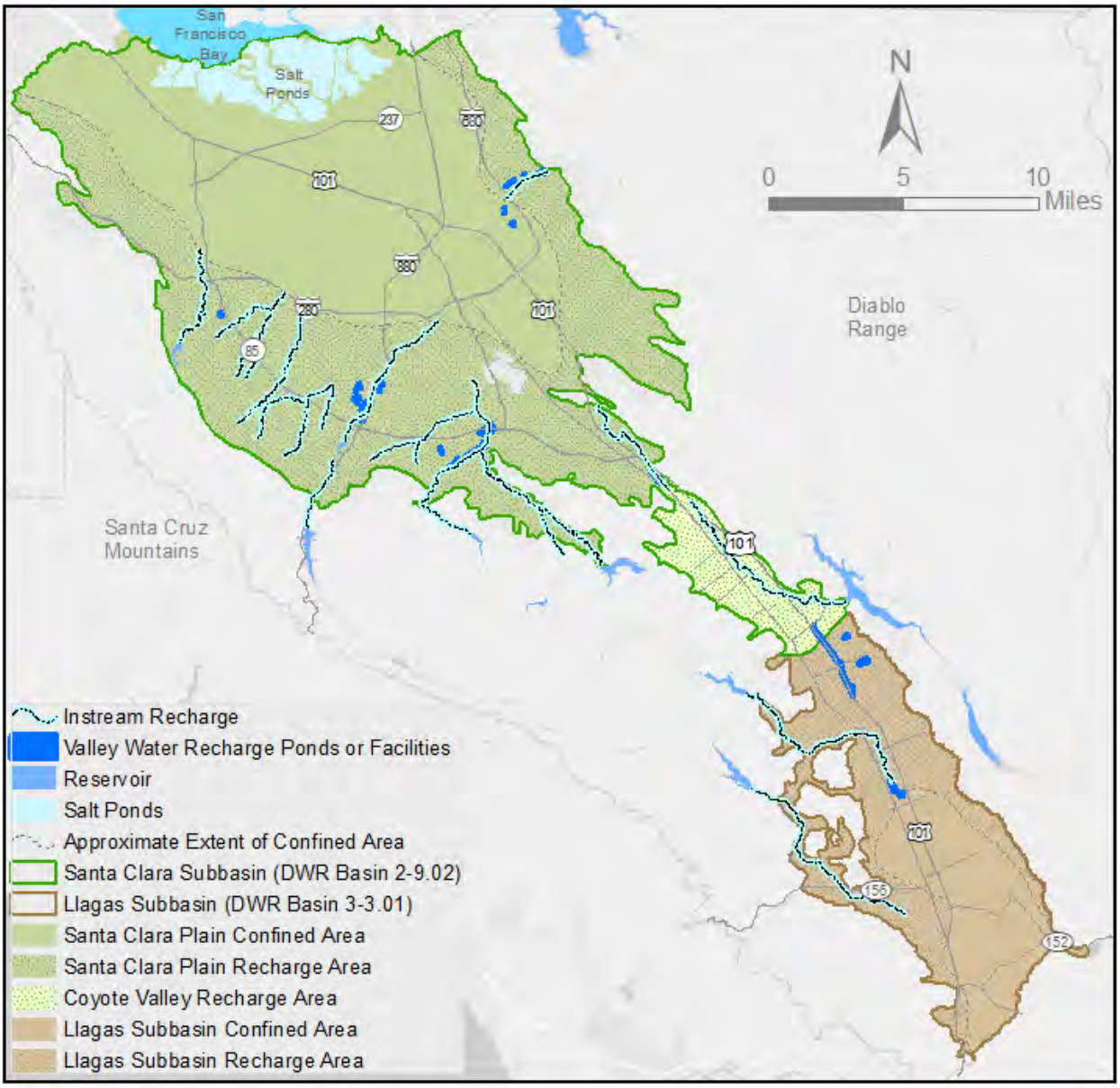
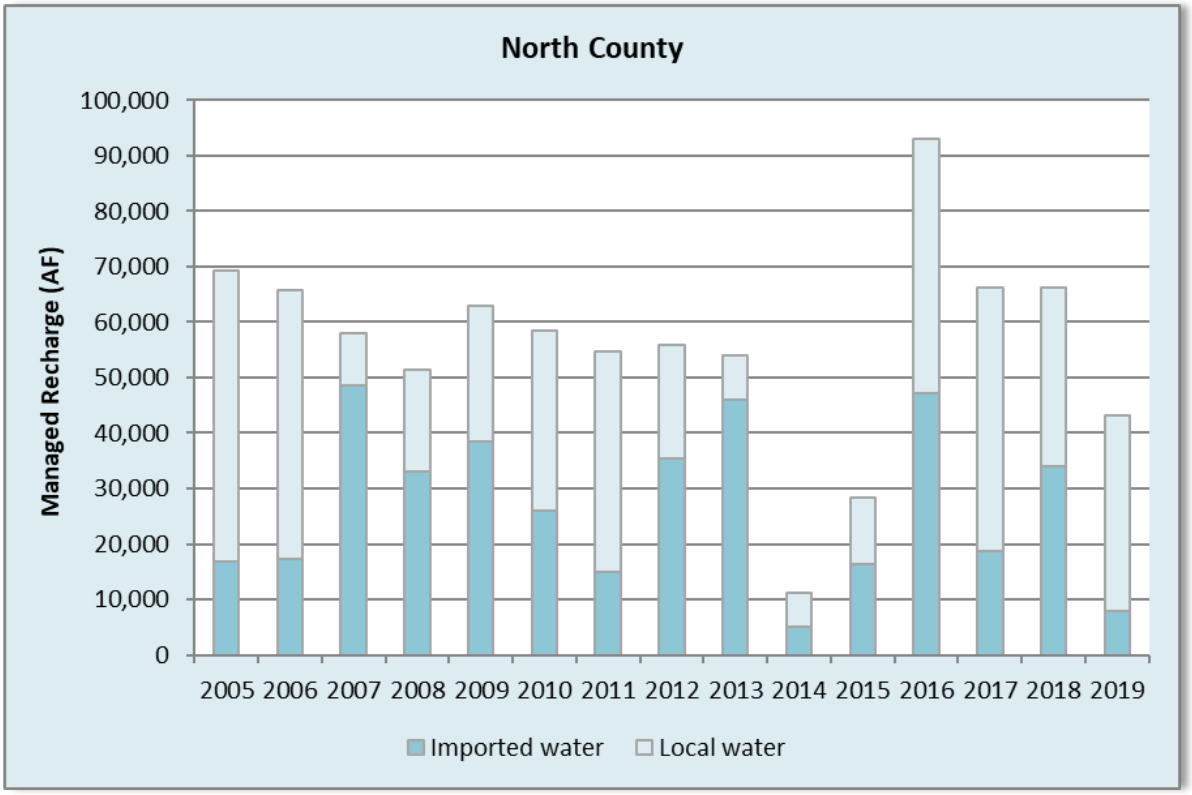
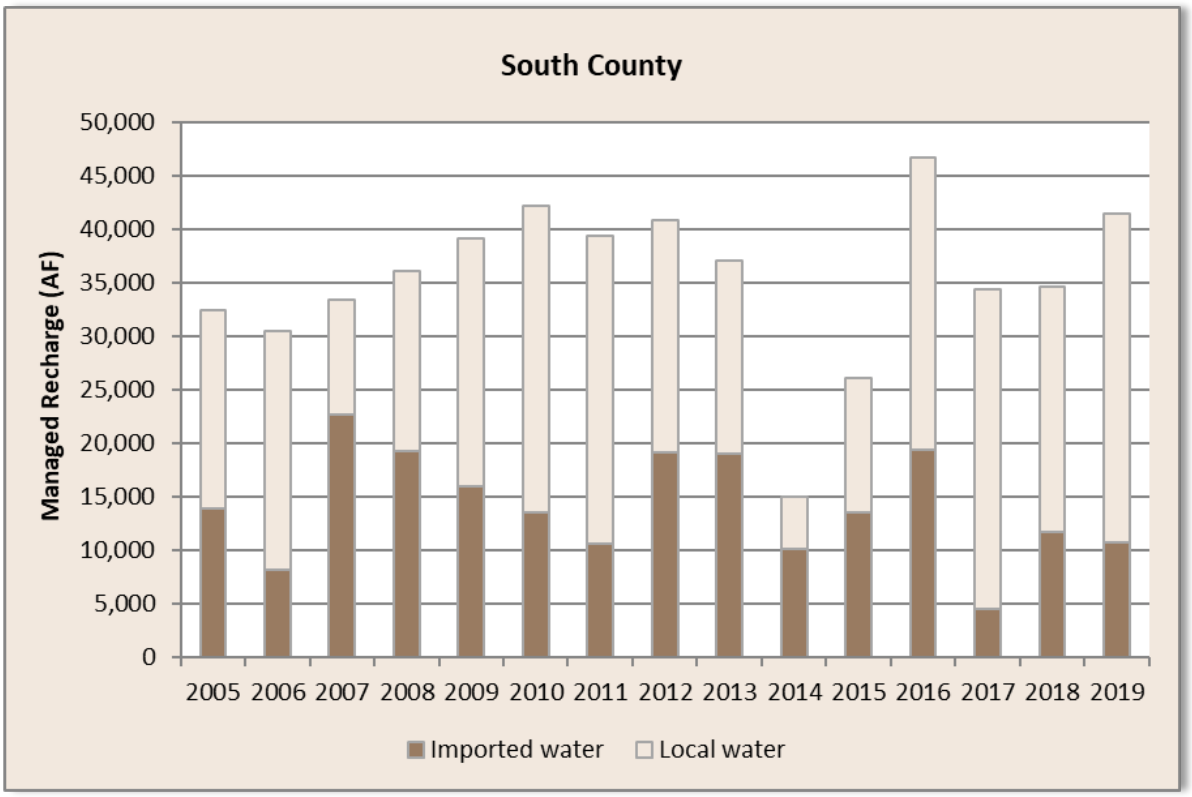


Figure 11. Managed Recharge by Source - North County and South County





Valley Water's 10 reservoirs were constructed in the 1930s and 1950s. Operating restrictions have been imposed on five of the reservoirs while seismic stability concerns are mitigated. These dam safety operating restrictions reduce the amount of water that can be stored for groundwater recharge by 55,000 AF but are needed to provide an adequate level of public safety. The restrictions result in a loss of about one third of the total surface storage capacity of Valley Water reservoirs. Current or upcoming Valley Water facility projects include seismic upgrades of Anderson, Calero, and Guadalupe dams, rehabilitation of Almaden Dam outlet works, replacement of Almaden Dam spillway, and rehabilitation of the Almaden-Calero Canal. The first phase of the seismic investigations of Coyote, Chesbro, and Uvas dams was concluded in 2019. The design of the Anderson Dam Seismic Retrofit Project (ADSRP) has progressed in 2019.

Recently, the Federal Energy Regulatory Committee (FERC) demanded that Valley Water begin draining Anderson Reservoir on October 1, 2020 down to deadpool. Draining the largest reservoir in the county is needed prior to removing the existing dam embankment and reconstructing the dam from the core up. To comply with the FERC order, Valley Water developed a Dewatering Plan and initiated another project, the FERC Order Compliance Project (FOCP). The FOCP proposes a set of interim risk reduction measures to protect the public from the risk of dam failure due to seismic activity and also a set of avoidance and minimization measures for the time period prior to construction and operation of the ADSRP to reduce the public safety, health, water supply, and environmental impacts of draining Anderson Reservoir. The FOCP consists of multiple components, three of which are heavy construction projects – a new Anderson Dam Tunnel with a low-level outlet pipe that can carry 2,000 cubic feet per second (cfs), an extension of the Cross Valley Pipeline to Coyote Creek downstream of Ogier Ponds, and a replacement of the Coyote Percolation Pond flashboard dam with an inflatable bladder dam. Valley Water's top priority is to complete the FOCP in 2023 and then complete the ADSRP by 2030.

In-Lieu Recharge

Valley Water's treated water deliveries, water conservation, and recycled water programs play a critical role in maintaining groundwater storage by reducing the demand on groundwater. In 2019, treated water and recycled water provided 102,000 and 17,000 AF, respectively. Valley Water's long-term water conservation programs also saved approximately 76,000 AF.[14]

Valley Water's Silicon Valley Advanced Water Purification Center began operating in 2014. This state-of-the-art facility in San Jose produces up to 8 million gallons per day, or 9,000 AF per year, of highly purified water by treating recycled water with microfiltration, reverse osmosis, and ultraviolet light. This purified water is then blended with tertiary-treated recycled water to improve the quality for landscape irrigation and industrial uses. This facility supports Valley Water's goal of expanding the use of recycled and purified water, which reduces the demand on groundwater and increases supply reliability.

2.3 Groundwater Balance

While groundwater storage may increase or decrease each year, Valley Water's comprehensive managed and in-lieu recharge programs ensure long-term balance. The annual groundwater balance presented evaluates annual inflows and outflows for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin, as shown in Figure 12. It should be noted that some terms presented in the groundwater balance cannot be directly measured and represent estimated values from Valley Water's calibrated groundwater flow models.

[14] Santa Clara Valley Water District, Protection and Augmentation of Water Supplies, FY 2020-21 (PAWS), 49th Annual Report, February 2020.

Inflows

Major inflows to the subbasins are primarily controlled by hydrologic conditions that include:

- Managed recharge by Valley Water, using local and imported surface water; and
- Natural recharge, which includes deep percolation of rainfall, natural seepage through creeks, subsurface inflow from adjacent aquifers, water loss from transmission and distribution lines, mountain front recharge, and return flows from septic systems and irrigation

Valley Water quantifies managed recharge using streamflow measurements and measured releases from reservoirs and raw water pipelines. Rainfall is measured at precipitation gage stations in San Jose (NOAA[15] Station USW00023293), Los Gatos (NOAA Station USC00045123), Coyote Valley (Valley Water Station 37), and Morgan Hill (Valley Water Station 41). These stations provide rainfall data used in each of Valley Water's three calibrated numerical groundwater flow models (MODFLOW) for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin. Subsurface inflows and outflows to and from adjacent aquifer systems and mountain front recharge are derived from Valley Water's calibrated groundwater flow models. Total inflows to all subbasins was 146,900 AF in 2019, with managed recharge providing 57% of total inflows (Figure 12).

Both locally and statewide, precipitation 2019 was above normal, and included several storm events characterized as "atmospheric rivers" that resulted in significant rainfall and surface water runoff. However, large storm events in a relatively short period of time do not typically provide a large amount of natural groundwater recharge due to high runoff and limited time for percolation. Estimated natural recharge in 2019 was 57,100 AF, approximately 133% higher than in 2018.

Outflows

The primary outflow of groundwater is pumping, which accounted for 84% of the total outflow of 131,700 AF in 2019. Most groundwater pumped is metered. In Zone W-2, meters are required for wells pumping more than 1 AFY of non-agricultural water or 4 AFY of agricultural water annually. In Zone W-5, meters are required for wells producing more than 2 AFY of non-agricultural water or 20 AFY of agricultural water. Where meters are not installed, crop factors are used to determine agricultural water use, whereas domestic use is estimated from a table of average uses. Subsurface outflow to adjacent aquifer systems, creeks, storm and sewer systems, and plant uptake was 21,300 AF, or 16% of the total outflow.

Change in Storage

There was an estimated increase in countywide storage of 15,200 AF in 2019 because the groundwater inflows exceeded the outflows. Compared to 2018, storage in the Santa Clara Plain, the Coyote Valley and Llagas Subbasin increased by 6,300 AF, 2,000 AF and 6,900 AF, respectively (Figure 12). This resulted in a total estimated storage of 356,700 AF. This is well within the "Normal" stage of Valley Water's Water Shortage Contingency Plan, which represents storage above 300,000 AF. Groundwater levels and storage are described in more detail in Chapter 3.

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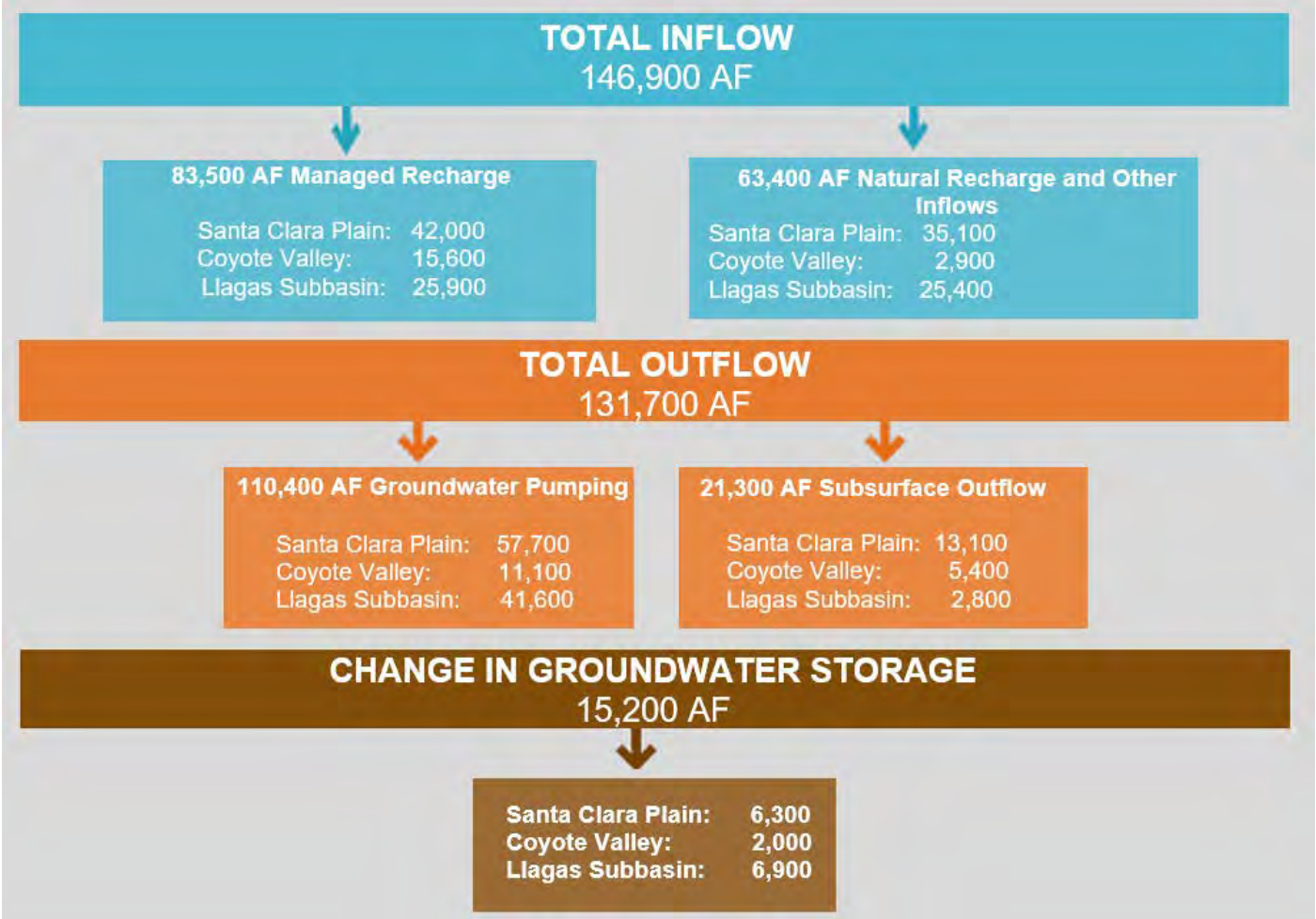
[15] U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA).

Figure 12. CY 2019 Groundwater Balance



Notes:

1. Groundwater balance terms presented are estimates as of March 2020. These estimates are refined as additional data becomes available. Values shown are based on measured quantities or calibrated groundwater flow models, with all values rounded to the nearest 100 AF.
2. Managed recharge represents direct replenishment by Valley Water using local and imported water. Estimates from the groundwater models may differ slightly from surface water accounting estimates.
3. Natural recharge and other inflows include the deep percolation of rainfall, septic system and/or irrigation return flows, natural seepage through creeks, storm and sewer system seepage, and inflow from adjacent aquifer systems.
4. The groundwater pumping estimate is based on pumping metered by Valley Water or reported by low-volume groundwater users.
5. Subsurface outflow represents outflow to adjacent aquifer systems. In the Santa Clara Plain, this includes outflows to San Francisco Bay; in the Coyote Valley, this includes outflow to the Santa Clara Plain; and in the Llagas Subbasin, this includes outflows to the North San Benito Subbasin in San Benito County.

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CHAPTER 3 – GROUNDWATER LEVELS AND STORAGE

Valley Water measured groundwater levels in 237 wells in 2019 and obtained water levels from an additional 112 wells measured by water retailers. After rising to pre-drought levels in 2017, groundwater levels throughout the county remained high in 2019 due to good water supply conditions and continued water use reductions. Groundwater reserves increased by an estimated 15,200 AF during 2019 because total recharge exceeded pumping and other outflows. The estimated end of 2019 groundwater storage was 356,700 AF, which is in the normal stage of Valley Water's Water Shortage Contingency Plan and is well above the Groundwater Management Plan (GWMP) storage target of 300,000 AF. Also, the projected end of year storage for 2020 is expected to be well above the 300,000 AF target.

3.1 Groundwater Levels

Comprehensive and accurate groundwater level data allows Valley Water to evaluate storage conditions and supports good operational decisions and water supply planning. In 2019, Valley Water measured depth to water at 237 wells on a daily to monthly basis and obtained similar data from 112 water retailer wells (Figure 13). As the designated monitoring entity for Santa Clara County under the California Statewide Groundwater Elevation Monitoring (CASGEM) program, Valley Water uploaded over 1,200 groundwater elevation measurements for 129 wells to the CASGEM website in 2019.

Three groundwater level index wells are used to represent broad regional conditions in the Santa Clara Plain, Coyote Valley, and Llagas Subbasin (Figures 13 and 14). Table 5 shows March and October 2019 groundwater elevations for these index wells; these months typically represent the seasonal high and low groundwater elevations, respectively. The 2019 average groundwater elevation was 1.9 feet lower than the previous year in the Santa Clara Plain, 4.5 feet higher in the Coyote Valley, and 5.4 feet higher in the Llagas Subbasin. Groundwater elevations remained well above the historical minima and above levels during the drought of 1987-1992 (Figure 14). Groundwater elevations were also well above the thresholds established to minimize the risk of land subsidence in all subsidence index wells throughout 2019.[16] All available groundwater elevation and depth-to-water data can be accessed on Valley Water's website at valleywater.org/groundwater.

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[16] To avoid resumption of permanent subsidence, Valley Water has established subsidence thresholds at ten index wells in the Santa Clara Plain as described further in Chapter 4.

Table 5. Groundwater Elevations at Regional Index Wells (feet, NGVD88)

Groundwater Subbasin/Area	Index Well	March 2019	October 2019	2019 Average	2018 Average	5 Year Average (2015-2019)	Period of Record Average
Santa Clara Subbasin, Santa Clara Plain	07S01W25L001	95.4	86.2	90.7	92.6	77.5	16.9
Santa Clara Subbasin, Coyote Valley	09S02E02J002	285.2	272.3	277.2	272.6	271.8	267.1
Llagas Subbasin	10S03E13D003/ 10S03E13E007	239.9	222.3	229.0	223.6	216.1	220.7

Note: The period of record for the index wells is 1936-2019 for the Santa Clara Plain, 1948-2019 for the Coyote Valley, and 1969-3/2019 from 10S03E13D003 and 11/2019-current from 10S03E13E007 for the Llagas Subbasin. The Llagas Subbasin well was replaced in November so there was no measurement for Llagas Subbasin in October 2019; the value shown is for November 2019.

Groundwater elevation contours for the principal aquifer zone in spring and fall of 2019 are shown in Figures 15 and 16. The spring and fall maps were created using the water level measurements closest to March 31, 2019 and September 30, 2019, respectively. The typical seasonal pattern observed is that groundwater levels peak in the spring and decline through the summer and fall due to increased pumping and less natural recharge; groundwater levels then usually start rising with the late fall and winter rains. While this pattern is apparent in Figures 15 and 16, the recent seasonal changes are not as pronounced as in some past years due to reduced pumping by major retailers.

In the Santa Clara Subbasin, the general groundwater flow direction is northwest from the Coyote Valley toward San Francisco Bay. Valley Water's managed recharge program helps maintain adequate pressures in the principal aquifer zone such that groundwater flows toward the bay and maintains an upward vertical gradient near the bay. The upward gradient minimizes the potential for saltwater intrusion into the principal aquifers. Artesian conditions occur in the confined area of the Santa Clara Plain and, in 2019, an increasing number of wells had groundwater with substantial artesian pressure.

The 2019 groundwater flow patterns observed in South County were similar to those observed in the past. In Coyote Valley, the highest elevations are at the divide between the Santa Clara Subbasin and the Llagas Subbasin near Cochrane Road and groundwater generally flows toward the northwest. The highest groundwater elevations in the Llagas Subbasin are in the recharge area in Morgan Hill, and groundwater generally flows southeast toward the Pajaro River and San Benito County. Managed and natural recharge within the recharge area maintains groundwater pressures within the southern confined area, where deeper groundwater occurs in partially to fully confined (artesian) conditions. Similar to the Santa Clara Plain, artesian pressures in the Llagas Subbasin increased in some wells in 2019.

Figure 13. CY 2019 Groundwater Level Monitoring

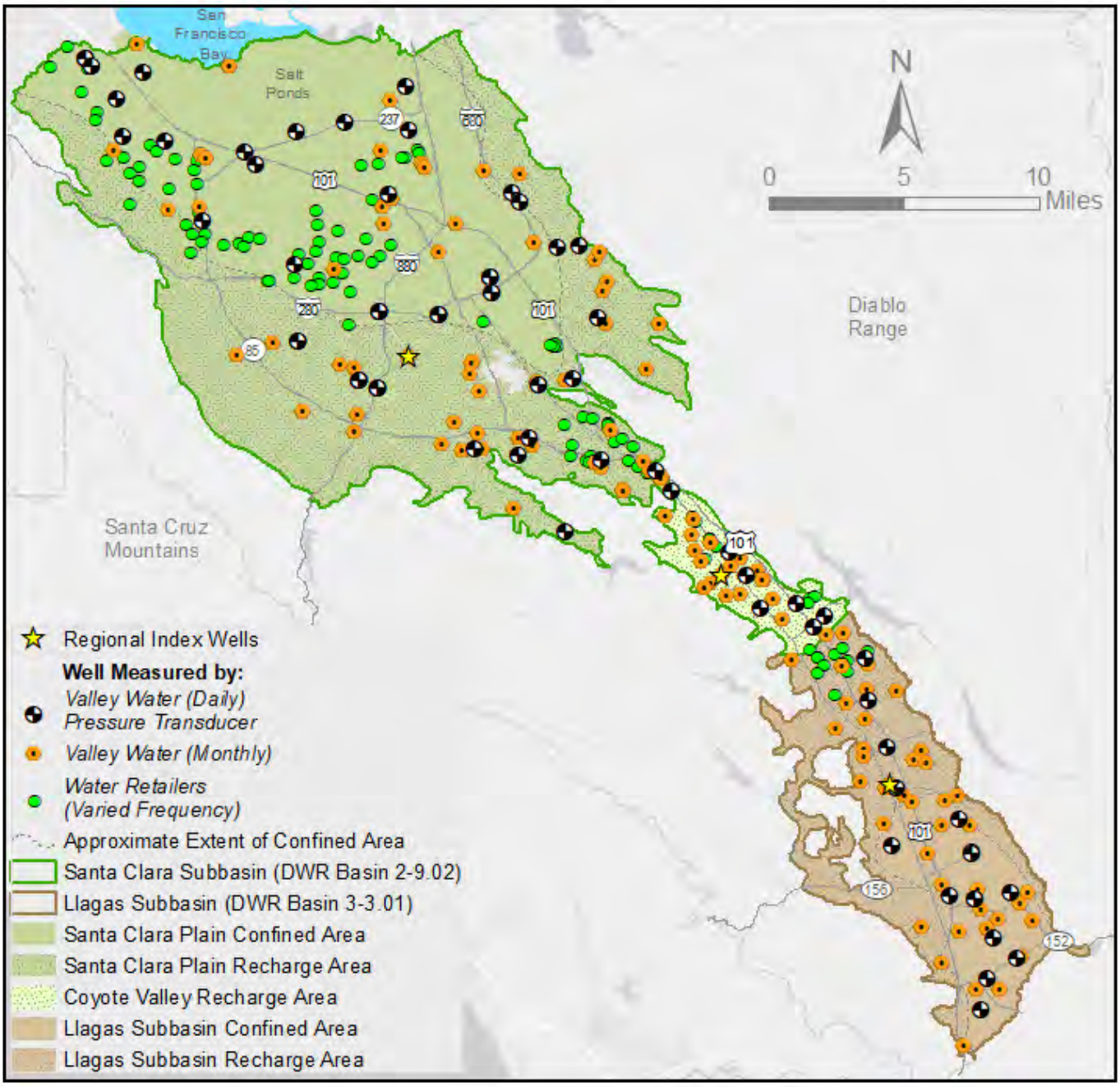


Figure 14. Groundwater Elevations at Regional Index Wells

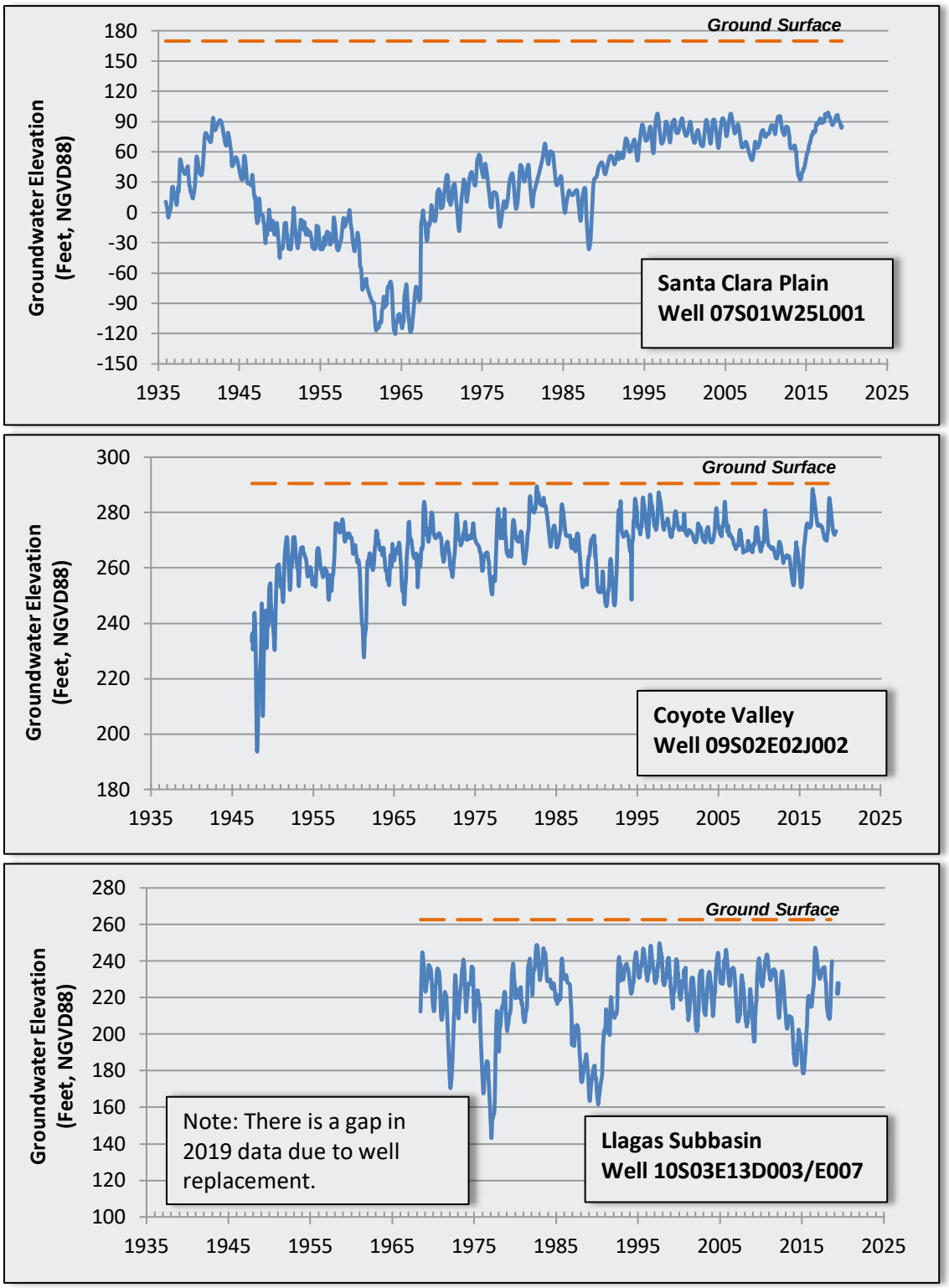


Figure 15. Spring 2019 Groundwater Elevation Contours in the Principal Aquifers

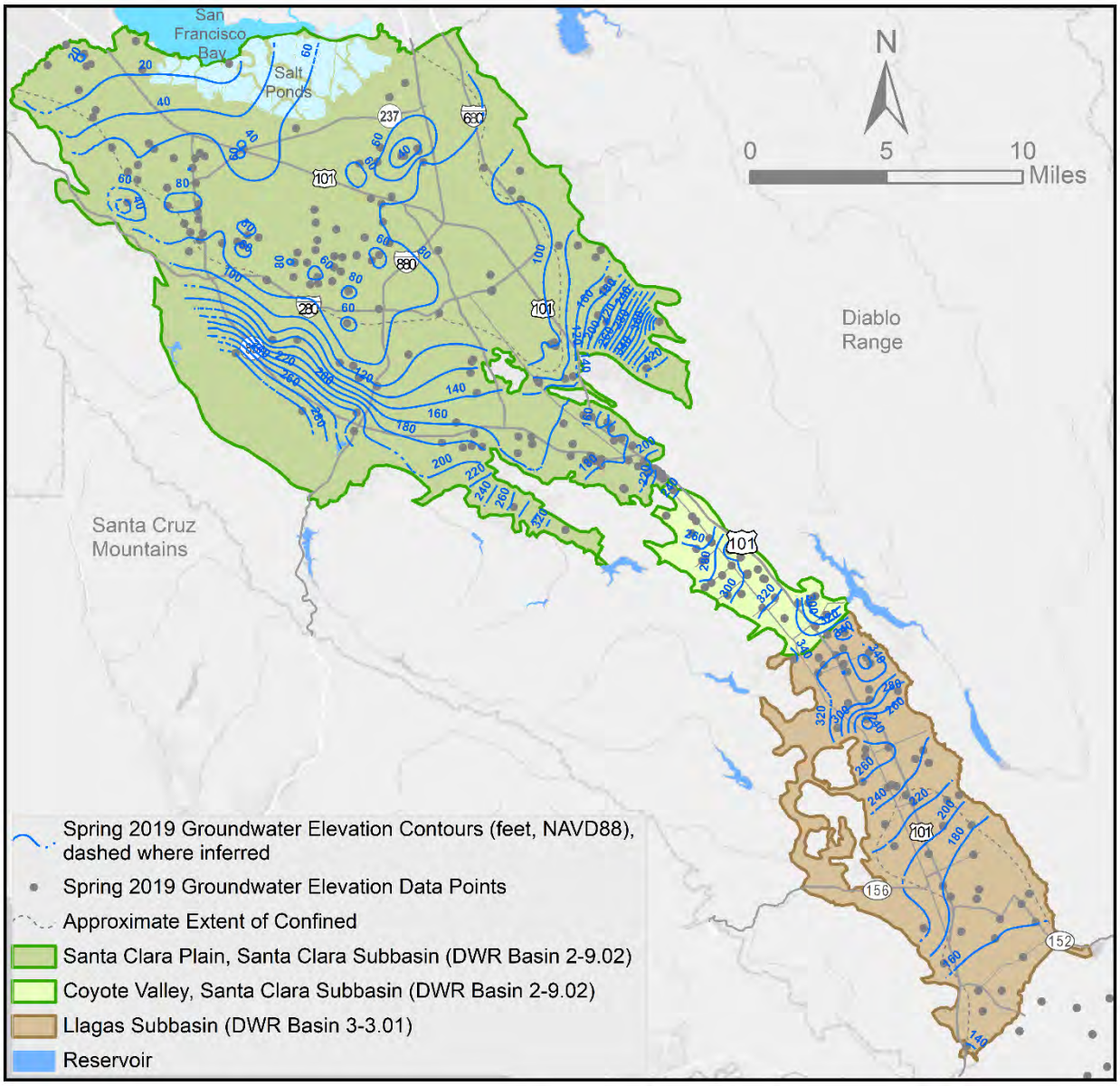
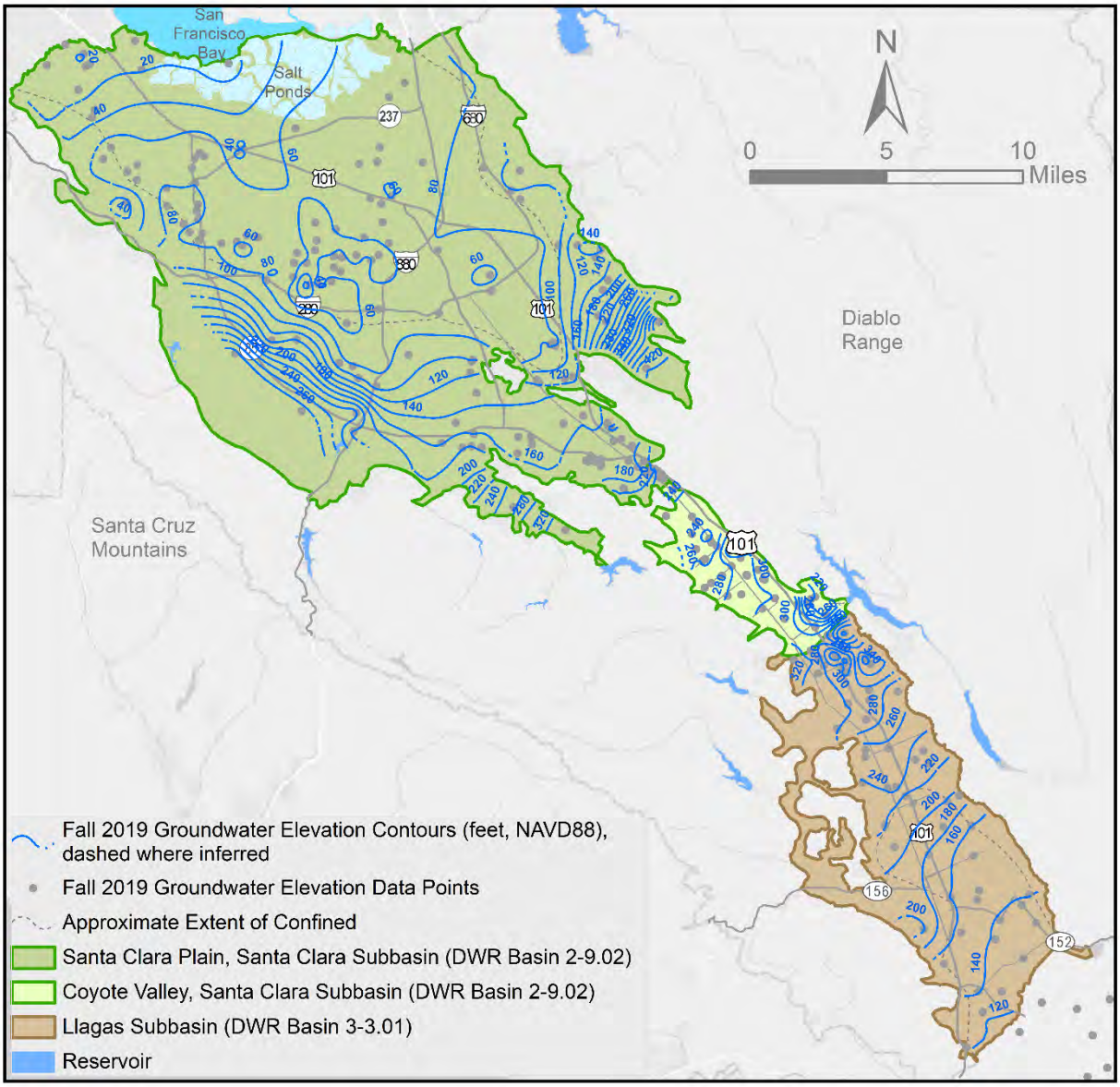


Figure 16. Fall 2019 Groundwater Elevation Contours in the Principal Aquifers



3.2 Groundwater Storage

Estimated countywide groundwater storage at the end of 2019 was 356,700 AF; this is well above the GWMP outcome measure of 300,000 AF, and 15,200 AF greater than 2018 (Table 6). End of year groundwater storage above 300,000 AF falls within the normal stage (Stage 1) of Valley Water's Water Shortage Contingency Plan, indicating good water supply conditions. The end of year storage for 2020 is projected to be well above the 300,000 AF target.

Table 6. Estimated End of Year Groundwater Storage (AF)

Groundwater Subbasin/Area	GWWP Outcome Measure	End of Year 2018	End of Year 2019	Change in Storage
Santa Clara Subbasin, Santa Clara Plain	278,000	309,400	315,700	+6,300
Santa Clara Subbasin, Coyote Valley	5,000	10,800	12,800	+2,000
Llagas Subbasin	17,000	21,300	28,200	+6,900
Total	**300,000**	**341,500**	**356,700**	**+15,200**

Note: Groundwater storage estimates presented are as of December 2019. These estimates are based on accumulated groundwater storage since 1970, 1991, and 1990 for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin, respectively. These estimates are refined as additional pumping and managed recharge data become available.

Groundwater Storage Outcome Measures

Valley Water met each of the three storage outcome measures in 2019 as shown below.

OM 2.1.1.a.: Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain.
Outcome measure met: End of 2019 groundwater storage is 315,700 AF.

OM 2.1.1.b.: Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley.
Outcome measure met: End of 2019 groundwater storage is 12,800 AF.

OM 2.1.1.c.: Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin.
Outcome measure met: End of 2019 groundwater storage is 28,200 AF.

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CHAPTER 4 – LAND SUBSIDENCE

Subsidence is a concern due to historical occurrence in the Santa Clara Plain and because it can lead to an increased risk of flooding, saltwater intrusion into groundwater, and damage settlement-sensitive infrastructure and utilities. In 2019, Valley Water monitored for subsidence at 138 benchmarks along three cross valley land surface level circuits and at two extensometers in the Santa Clara Plain. Groundwater levels at ten subsidence index wells were also monitored and compared to thresholds established at each well to minimize the risk of permanent land subsidence. The subsidence outcome measure was met in 2019 with subsidence below the threshold of 0.01 feet per year. In fact, close to zero subsidence occurred in 2019 in the Santa Clara Plain, indicating very good conditions. Subsidence has never been observed in the Coyote Valley or the Llagas Subbasin, so there is no related outcome measure in those areas.

Between 1915 and 1969, land subsidence occurred in the Santa Clara Plain due to groundwater overdraft, with more than 13 feet of inelastic (permanent) land subsidence observed in San Jose. Inelastic subsidence was essentially halted by about 1970 through Valley Water's expanded conjunctive water management programs, which facilitated the return of groundwater to levels well above subsidence thresholds. Elastic (non-permanent) subsidence and recovery occurs annually in response to seasonal pumping and recharge as indicated by satellite studies and extensometer measurements (Appendix A).[17] To avoid resumption of inelastic subsidence, Valley Water has established subsidence thresholds at ten index wells in the Santa Clara Plain.[18] A tolerable rate of 0.01 feet per year of subsidence was used to determine thresholds at these wells.[19] These subsidence thresholds are the groundwater levels above which groundwater must be maintained to ensure a low risk of land subsidence.

Valley Water conducts ongoing monitoring of land surface benchmarks, extensometers, and groundwater levels at subsidence index wells to determine if land subsidence is occurring and threatening to exceed established thresholds. The subsidence monitoring network is shown in Figure 17. Recent monitoring data from land benchmark surveys, extensometers, and subsidence index wells indicate that there is low risk of subsidence, as described further below and in the 2019 Subsidence Data Analysis Technical Memorandum (Appendix A).

4.1 Extensometer Monitoring

Valley Water monitors two 1,000-foot deep extensometers that measure aquifer compaction or expansion, associated with subsidence or uplift, by comparing vertical ground elevation relative to a central, isolated pipe set beneath the water-bearing units. The extensometers, located in Sunnyvale near Moffett Field ("Sunny") and near downtown San Jose ("Martha"), are equipped with data loggers to provide hourly aquifer compaction/expansion and water level readings. Valley Water evaluates the average land subsidence measured during the last 11 years at two extensometers to determine if it meets the tolerable rate of land subsidence of 0.01 feet per year[2].

Over the last 11 years (2009 to 2019), a negative average annual rate of subsidence (-0.006 feet per year) was measured at the extensometers (Figure 18), which is indicative of uplift (or aquifer expansion) and is below the tolerable subsidence rate of 0.01 feet per year. The average annual rate for the previous 11-year period (2008 to 2018) was -0.004 feet per year. The decreased value in 2019 results from continued high groundwater levels throughout much of the Santa Clara Plain.

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[17] Schmidt, D. A., and R. Bürgmann, 2003, Time-dependent land uplift and subsidence in the Santa Clara valley, California, from a large interferometric synthetic aperture radar data set, *J. Geophysical Res., 108* (B9), 2003.

[18] Geoscience Support Services Inc. for Santa Clara Valley Water District, Subsidence Thresholds in the North County Area of Santa Clara Valley, 1991.

[19] The tolerable subsidence rate of no more than 0.01 feet per year on average was endorsed by Valley Water's Water Retailer Groundwater Subcommittee.

4.2 Benchmark Elevation Surveys

Periodic benchmark surveys of land surface elevation have been conducted in Santa Clara County since 1912.[20] Valley Water's current benchmark leveling program consists of annual surveys along three cross valley level circuits in the Santa Clara Plain (Figure 17). In 2019, Valley Water analyzed land surface elevation data from 138 benchmarks to evaluate the spatial variability of land subsidence. 2019 survey data indicate little change of the land surface elevation from 2018. Figure 19 presents the average annual change of land surface elevation along the three circuits over the last 11 years from 2009 to 2019. It shows that subsidence (or negative values) was observed at some locations and uplift (or positive values) at most locations. No subsidence exceeding 0.01 feet per year was observed. The tolerable rate of subsidence of 0.01 feet per year was met during this period.

4.3 Subsidence Index Wells

Groundwater level measurements are an integral part of land subsidence monitoring because declining water levels due to long-term overdraft were the driving force of historical subsidence in the Santa Clara Plain. Valley Water measures water levels at ten subsidence index wells on a daily to monthly basis to determine if water levels are nearing established subsidence thresholds. If water levels stay near or drop below subsidence thresholds for extended periods, permanent land subsidence may resume, resulting in an increased risk of flooding, saltwater intrusion, and damage to infrastructure and utilities.

Figure 20 shows groundwater levels and subsidence thresholds at the ten subsidence index wells. The lowest historical water levels were generally observed in the 1960s and 1970s. Since then, groundwater levels have recovered, primarily due to Valley Water's managed recharge and in-lieu recharge programs. Similar to the regional groundwater elevation index wells, 2019 average water levels are close to or at historic highs in all subsidence index wells, indicating a full recovery of the groundwater resource since the last drought. Three subsidence index wells located near the Baylands continue to have upward vertical gradients and artesian conditions. In addition to keeping water levels above subsidence thresholds, maintaining an upward hydraulic gradient in the principal aquifer zone is critical for preventing shallow groundwater with elevated salts from entering the principal aquifer through abandoned wells and other vertical conduits. Valley Water will continue to frequently track data from the subsidence index wells to support water supply operations and planning.

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[20] USGS, Land Subsidence in the Santa Clara Valley, California as of 1982, Professional Paper 497-F, 1988.

Figure 17. Land Subsidence Monitoring Network

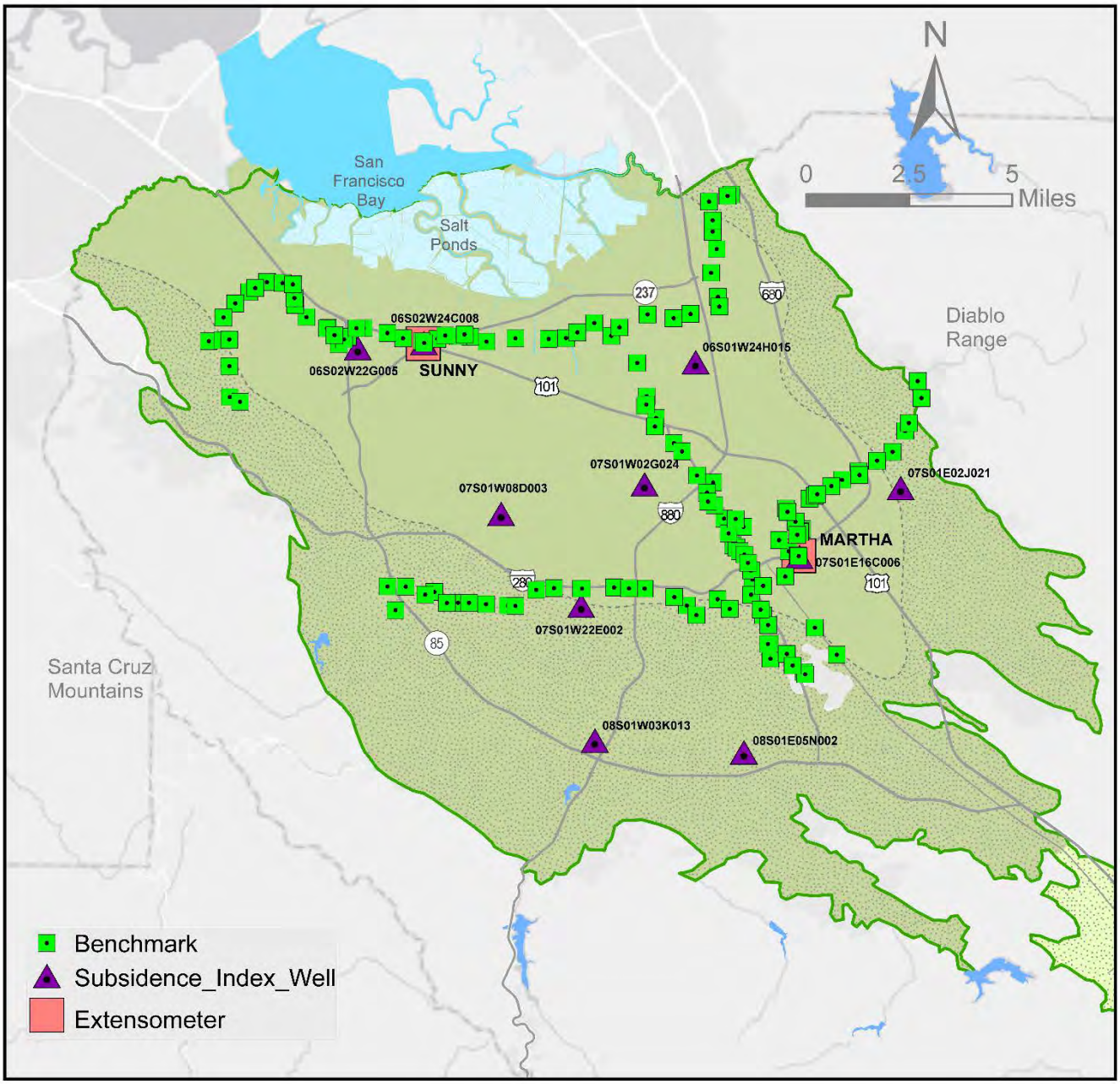
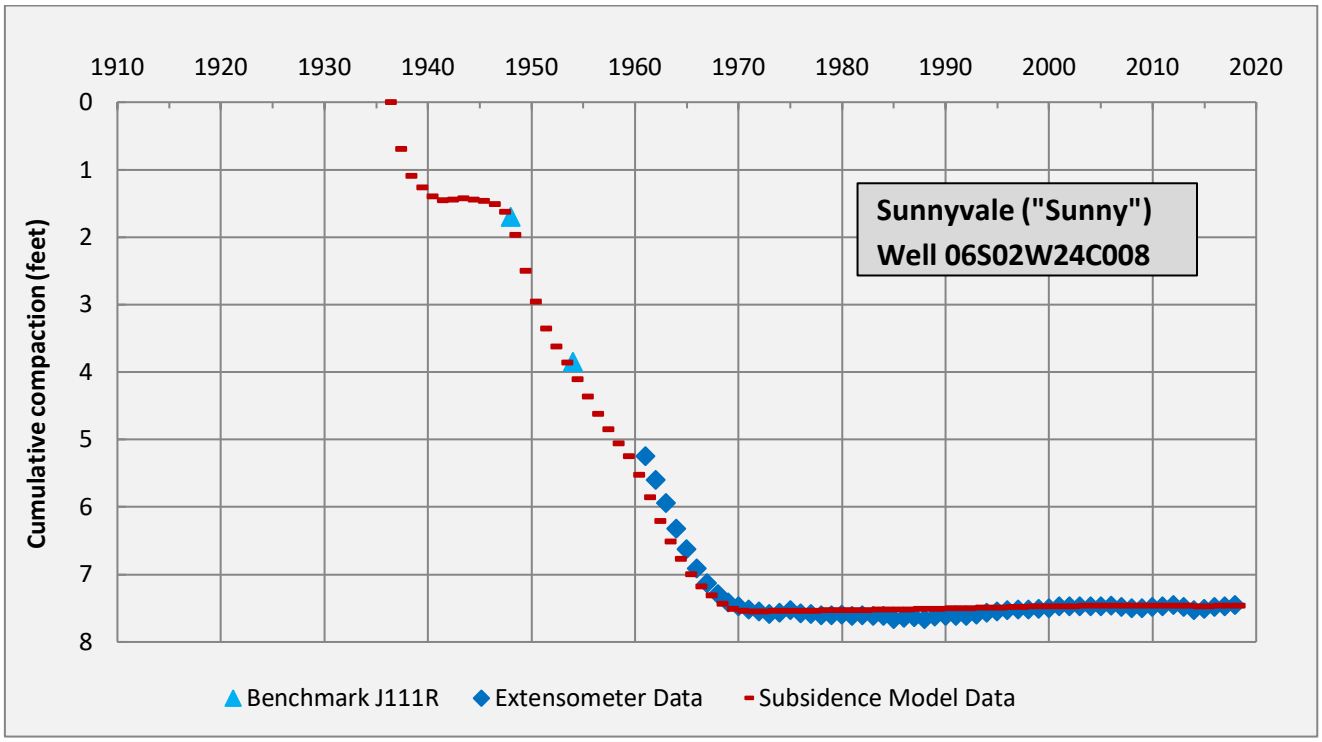


Figure 18. Cumulative Compaction at Extensometers



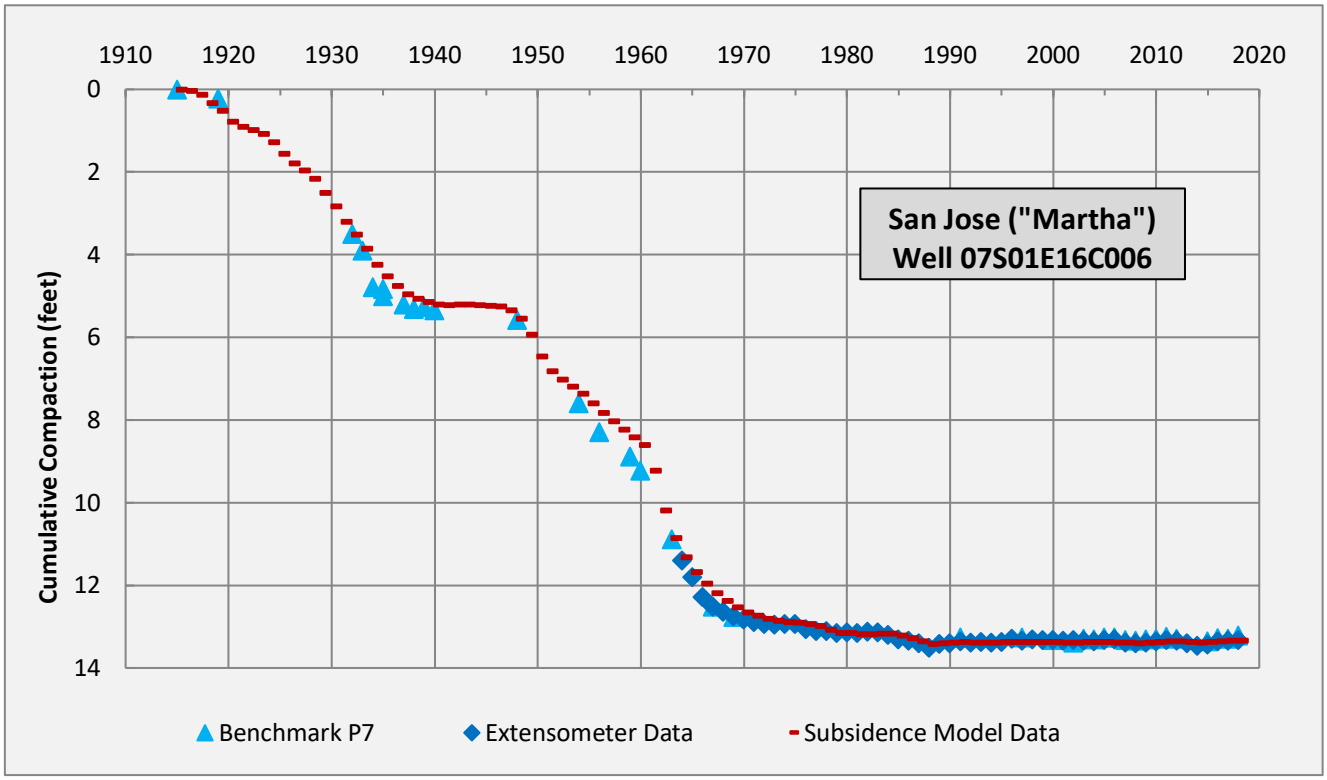
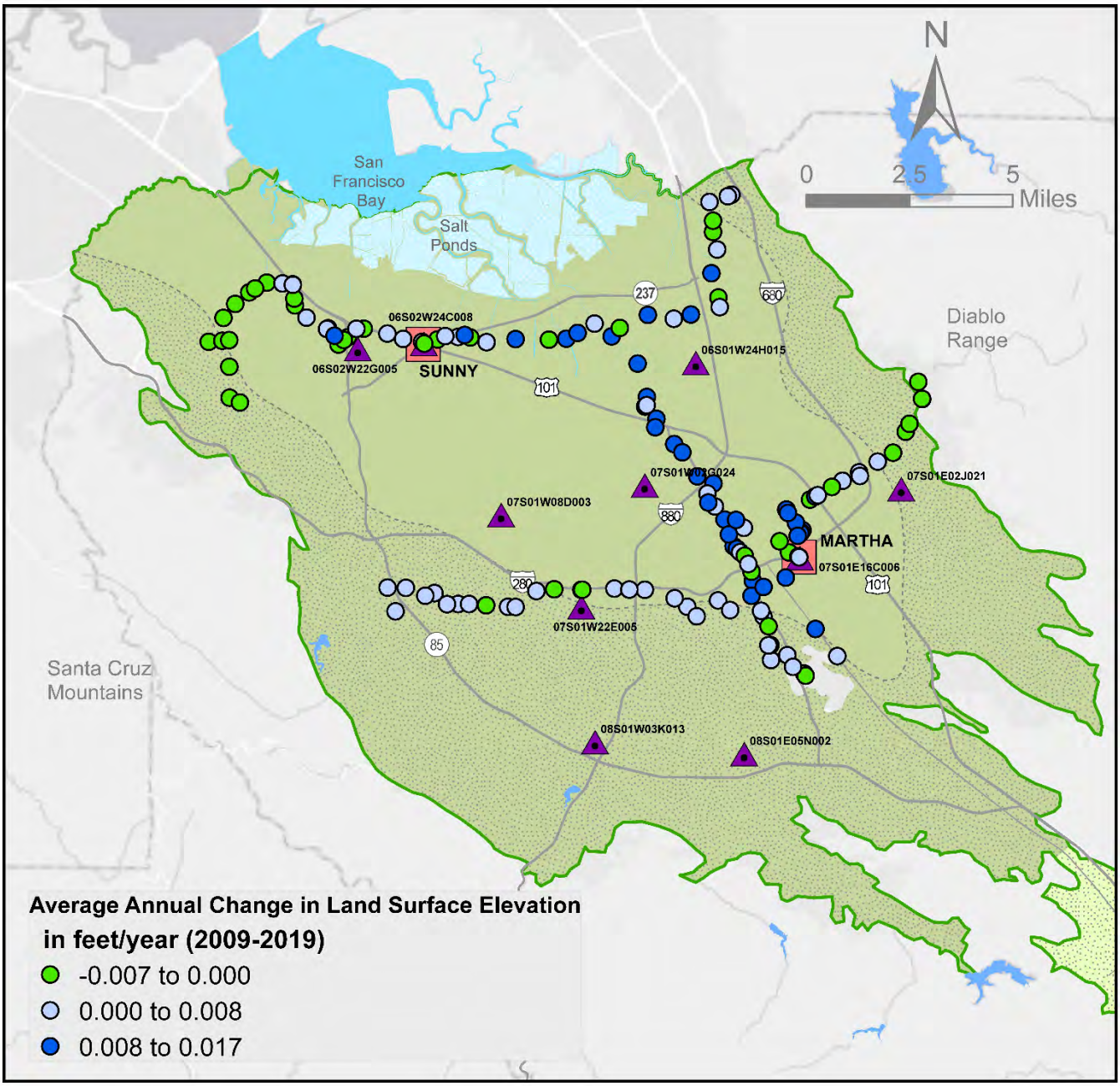


Figure 19. Average Annual Change of Land Surface Elevation between 2009 and 2019



Note: positive values indicate land surface uplift and negative values indicate land surface subsidence in Figure 19.

Figure 20. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88)

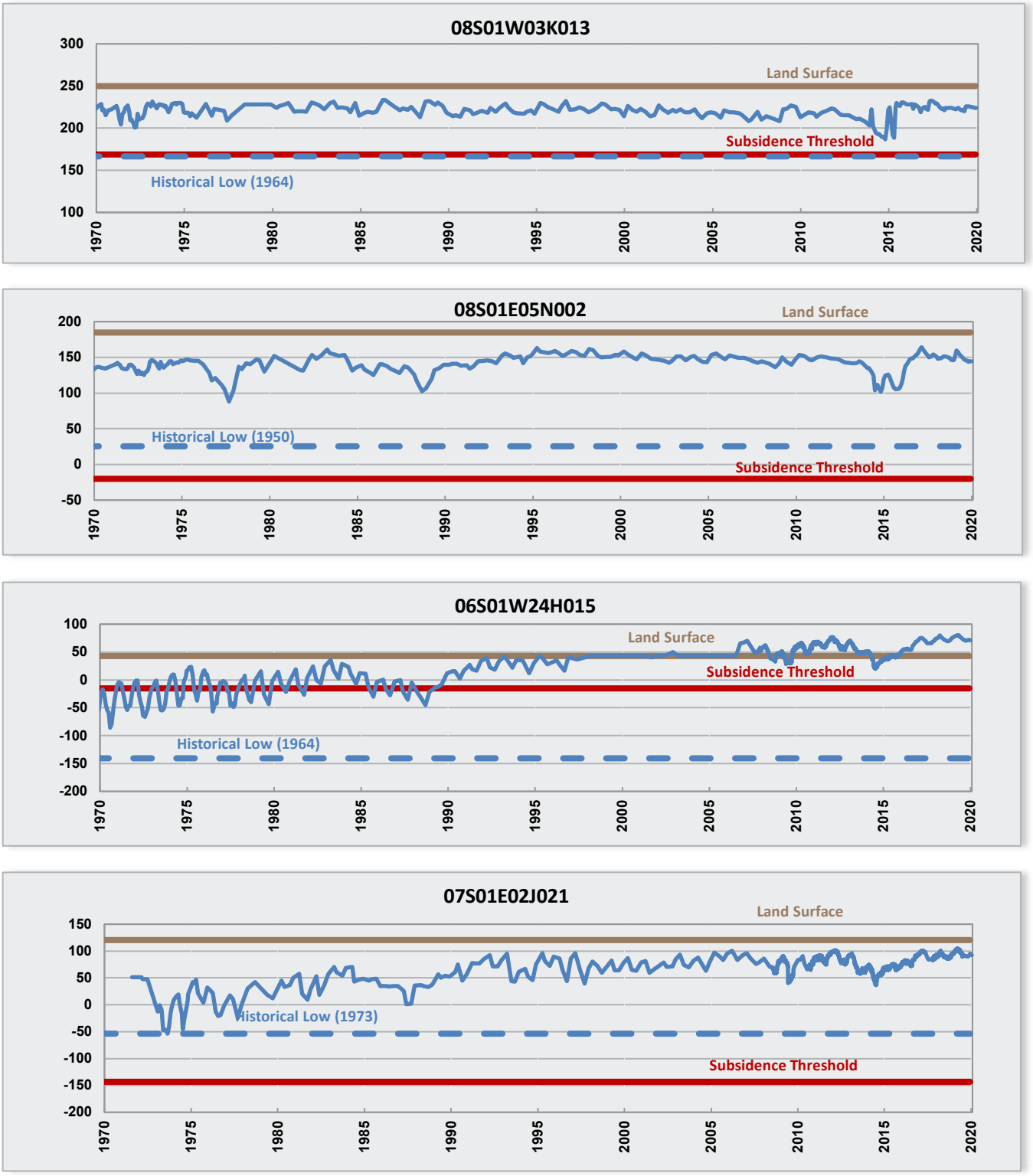


Figure 20. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88 continued)

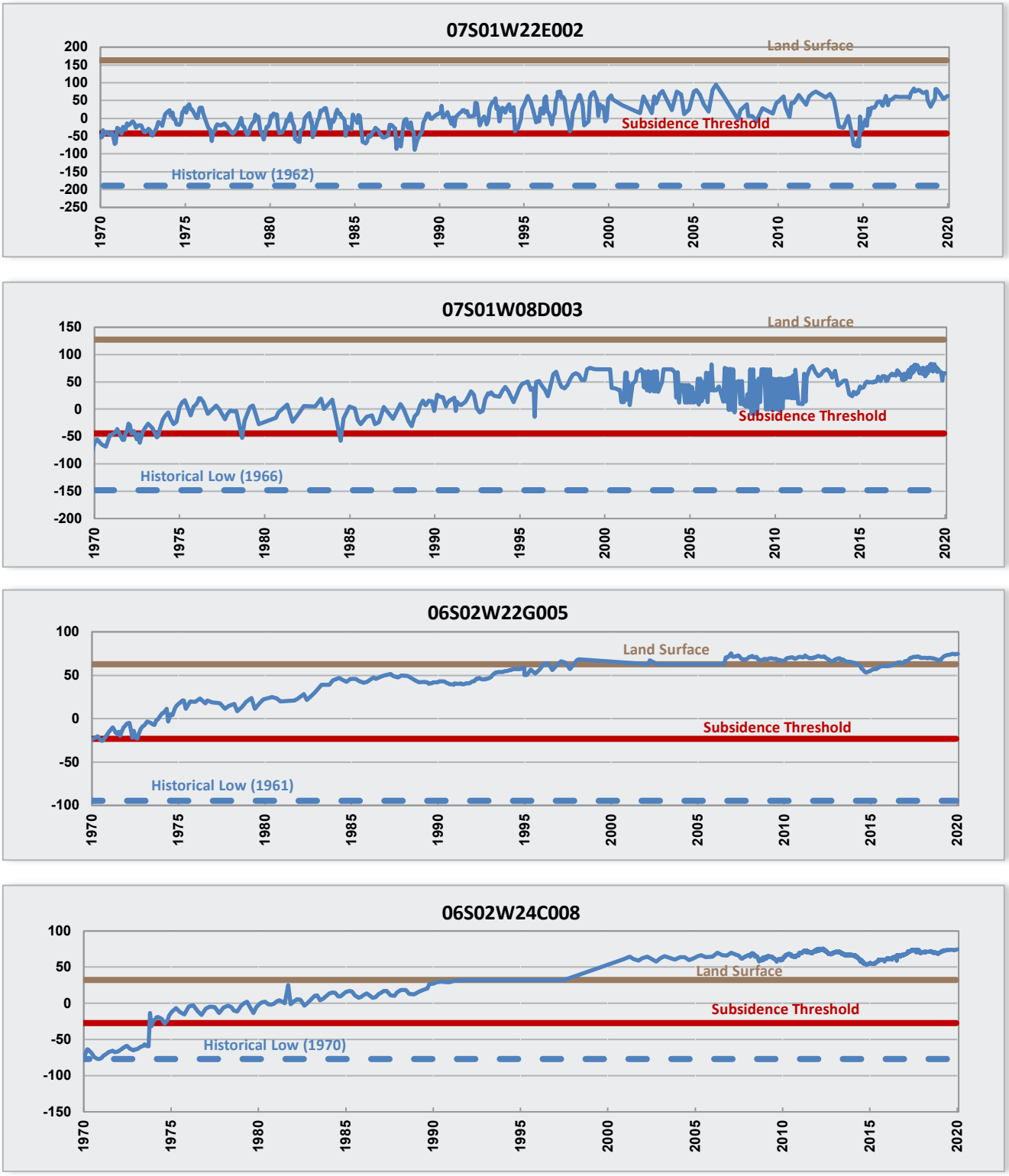
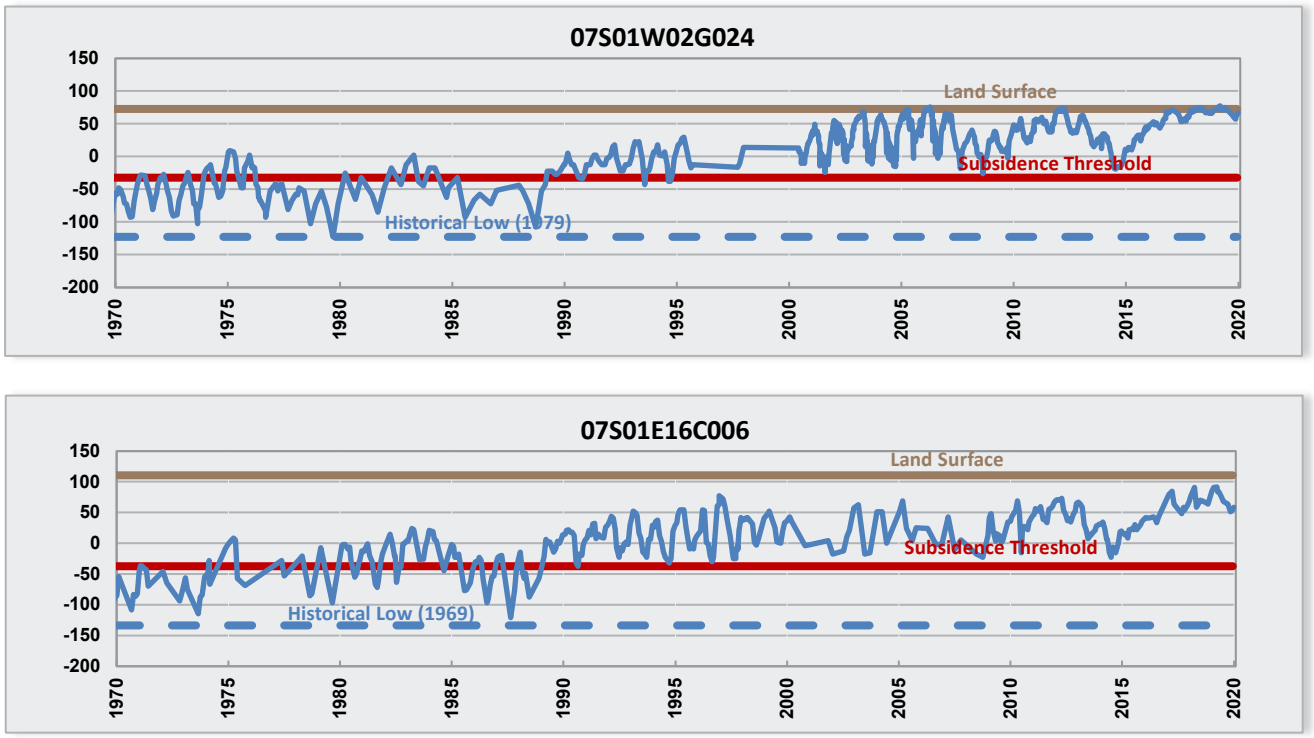


Figure 20. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88 continued)



Land Subsidence Outcome Measure

As shown in Figures 19 and 20 and described in this chapter, Valley Water's land subsidence outcome measure was met in 2019.

OM 2.1.1.d.

100% of subsidence index wells with groundwater levels above subsidence thresholds.
This outcome measure was met. Groundwater levels were above subsidence thresholds at all ten Santa Clara Plain subsidence index wells.

CHAPTER 5 – GROUNDWATER QUALITY

In 2019, Valley Water collected groundwater samples from 254 wells and analyzed the water quality. This included 85 dedicated monitoring wells and domestic wells that are sampled each year, 144 domestic wells tested through a voluntary sampling program, and 25 located wells near recycled water irrigation sites. Valley Water also analyzed groundwater quality data from 232 public water supply wells.[21] Summary results for water supply wells are provided in the Annual Groundwater Quality Summary Report (Appendix B). Summary tables of analyzed parameters with the median and range for each subbasin and aquifer zone[22] for all regional wells sampled are provided in Appendix C. These tables do not include results from wells near recycled water irrigation sites, which are included in Appendix E.

Water quality testing indicates that groundwater in the Santa Clara and Llagas Subbasins meets drinking water standards in most wells for all parameters tested. The exception is nitrate, which was found above regulatory standards in 23% of South County water supply wells sampled (primarily domestic wells) due to historic and on-going sources. The Salt and Nutrient Management Plan[23] implementation supports reduced nitrate loading and exposure. Valley Water also offers eligible domestic well owners free water testing for nitrate, as well as rebates of up to $500 for qualifying nitrate treatment systems.

During 2019, Valley Water conducted water quality sampling of the Coyote, Los Gatos, and Westside recharge systems. No parameters were detected above primary or secondary drinking water standards in 2019, nor since the program began in 2006. Water quality from these three recharge systems provides a high-quality water supply source for recharge into the Santa Clara and Llagas Subbasins. Recharge water quality sampling results for 2019 are summarized in Section 5.4 and related tables are provided in Appendix D.

Valley Water also monitors groundwater quality at wells near recycled water irrigation sites. In 2019, Valley Water analyzed data from 10 monitoring wells in the Santa Clara Plain and 20 wells in the Llagas Subbasin. In the Santa Clara Plain, there are mixed concentration trends for basic water quality parameters. Groundwater in the Llagas Subbasin generally shows stable or decreasing concentration trends for key recycled water indicators. Based on an analysis of wastewater indicators, concentration trends and geochemistry, it appears that some changes in both subbasins may be due to recycled water irrigation. Related results are summarized in Section 5.5 and data tables are provided in Appendix E.

Valley Water continues to track emerging technical and regulatory issues related to per- and polyfluoroalkyl substances (PFAS), a group of widely used but unregulated chemicals with known and suspected adverse health effects. Valley Water conducts ongoing PFAS sampling near recycled water irrigation sites in the Llagas Subbasin. In 2020, Valley Water expanded efforts to determine the extent and occurrence of PFAS in groundwater throughout Santa Clara County, including regional sampling.[24] Results indicate that PFAS are detected in some wells, but not widely present above current State health-advisory levels. The 2020 sampling data and interpretation will be included in the CY 20 Annual Groundwater Report.

Valley Water continues to coordinate with local, state, and federal agencies managing cleanup of groundwater contamination sites by tracking progress on high-priority sites and issuing recommendations for effective remediation. Valley Water will continue to track water quality changes and work with stakeholders to identify ways to protect groundwater quality from the threat of contamination.

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[21] Data for public water systems is available from the State Water Resources Control Board Division of Drinking Water website.
[22] Public water supply wells were assumed to represent the principal aquifer is no construction information was available, as these are typically deep wells.
[23] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-studies
[24] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-quality

5.1 Regional Groundwater Quality

Valley Water analyzed groundwater quality at 85 locations that are sampled annually, including 64 monitoring wells and 19 domestic wells (Figure 21). Sixty-nine samples were analyzed for almost 100 water quality parameters including major and minor ions, nutrients, trace metals, and volatile organic compounds (VOCs). Water from 16 shallow monitoring wells near the San Francisco Bay, used for salt water intrusion monitoring, were analyzed for ions and metals only. The regional groundwater quality evaluation also incorporates data from 50 wells with known construction sampled through Valley Water's voluntary domestic well sampling program and data from 232 public water supply wells sampled by public water systems and reported to the State Water Resources Control Board Division of Drinking Water (DDW).

To evaluate regional conditions, water quality results are compared to state and federal water quality standards and to prior year results. A summary table of sampled parameters showing the median and range for each subbasin and aquifer zone[25] is provided in Appendix C. Results indicate that groundwater in the Santa Clara and Llagas subbasins is generally of high quality. Water quality indicators, ions, and trace elements were within the normal range expected in groundwater, except for nitrate. Elevated nitrate concentrations are primarily an issue in South County due to historic and ongoing sources including synthetic fertilizer, septic systems, and animal enclosures.

Median concentrations for nitrate and TDS were compared to historical median concentrations and plotted over time (Figure 22). The median nitrate concentrations in the Santa Clara Plain shallow and principal aquifers in 2019 were 0.8 and 3.1 milligrams per liter (mg/L) as nitrogen (N), respectively, a decrease when compared to last year. Compared to 2018, the 2019 median for TDS is marginally higher in the Santa Clara Plain principal aquifer. The 2019 median concentration for TDS is the Coyote Valley is similar to 2018. The 2019 median concentrations in the Llagas Subbasin shallow and principal aquifers were 6.1 and 4.7 mg/L, respectively, a decrease when compared to last year. The 2019 TDS median concentrations in the Llagas Subbasin are similar to 2018.

Median nitrate values were below the drinking water standard of 10 mg/L in all three management areas. Median values for TDS were at or below 451 milligrams per liter (mg/L) in all groundwater management areas, below the secondary MCL. Fluctuations in annual sample medians are expected due to the number of wells tested with annual sampling recurrence, the number of wells tested with known well depths, annual recharge, pumping, and rainfall. Overall, median nitrate and TDS concentrations in the principal aquifers of the Santa Clara and Llagas subbasins remain stable (Figure 22). The evaluation of groundwater quality trends at five, ten, and fifteen-year periods, which also indicate generally stable or decreasing long-term trends, are presented in Section 5.2.

Eighteen VOCs, which include disinfection byproducts, were detected in groundwater in 2019, as summarized and listed by subbasin in Table C-4 (Appendix C). However, none were confirmed to be present above the Maximum Contaminant Level (MCL) and maximum concentrations were typically well below the MCL. VOCs occur primarily from industrial use of solvents and from leaking underground fuel tanks. No pesticide compounds were detected above the MCL in 2019.

[25] Public water supply wells were assumed to represent the principal aquifer if no construction information was available, as these are typically deep wells.

Figure 21. CY 2019 Groundwater Quality Monitoring Wells

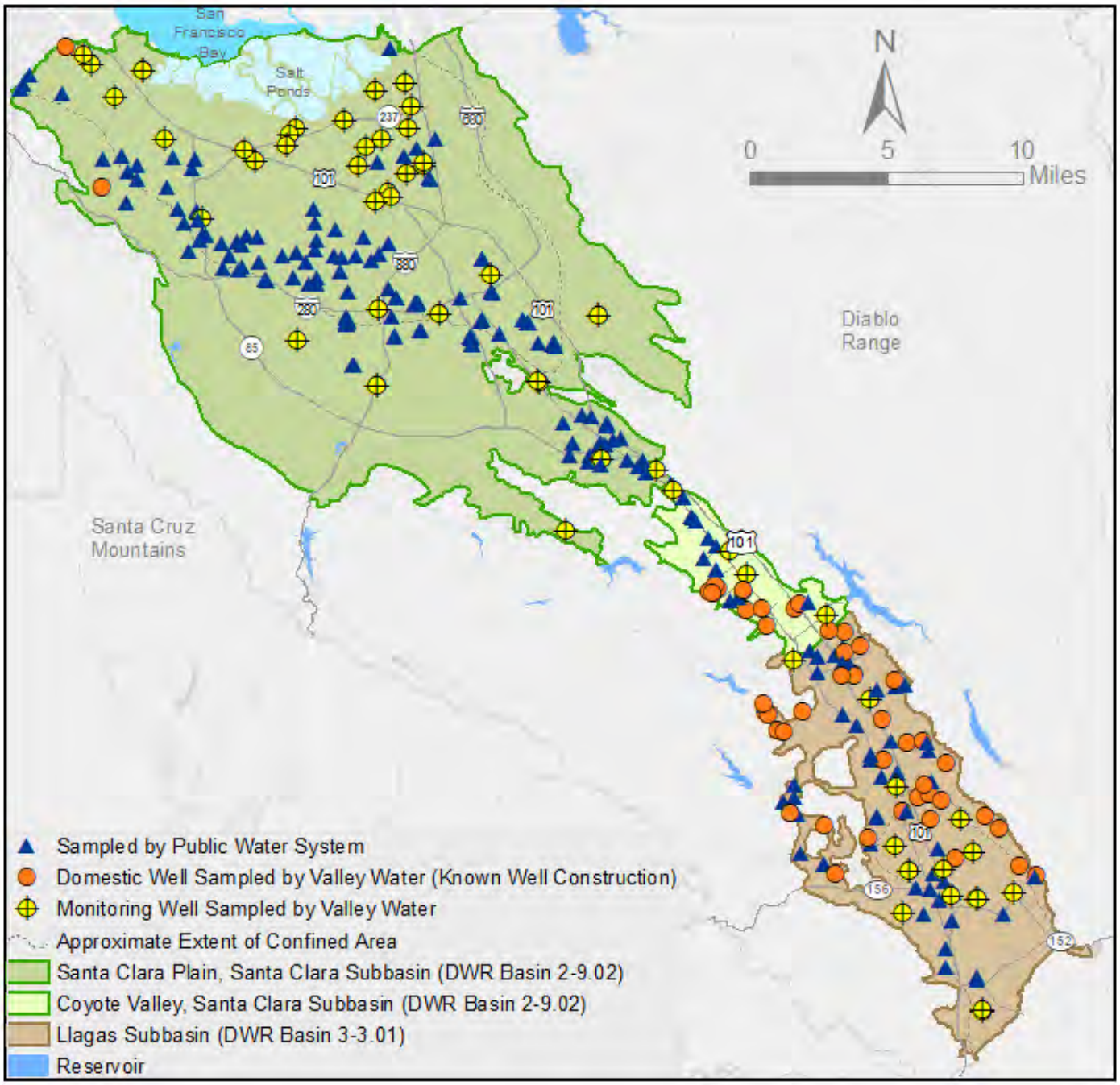
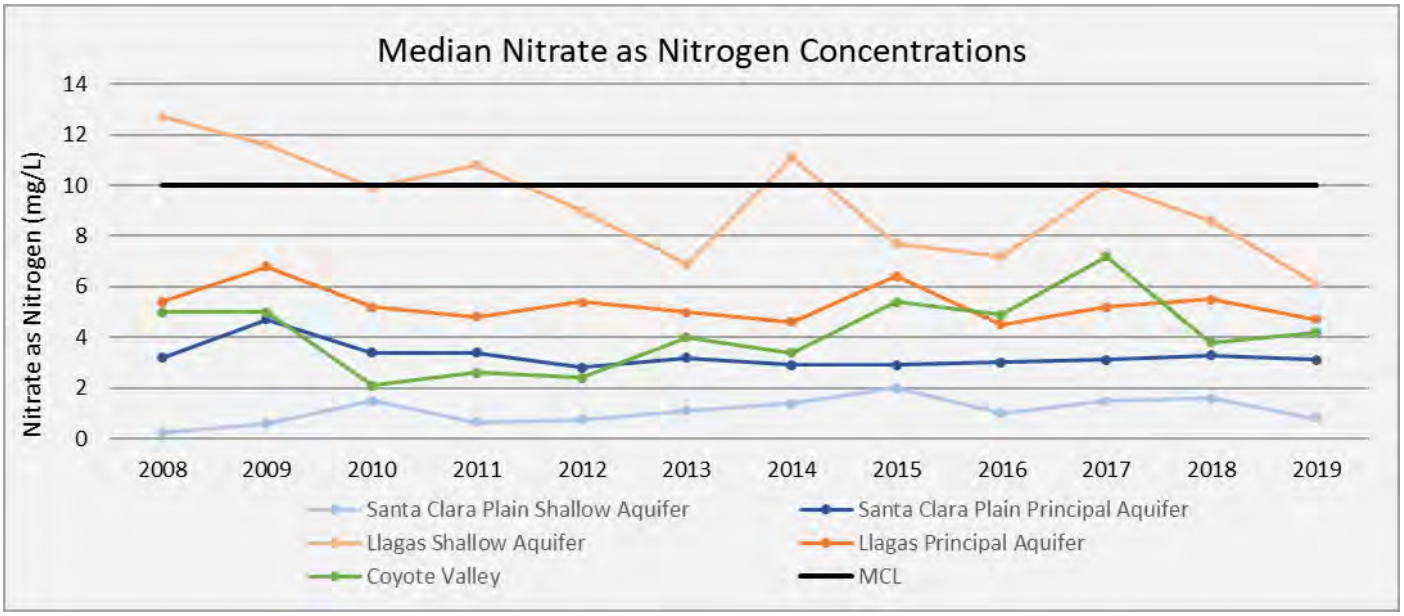
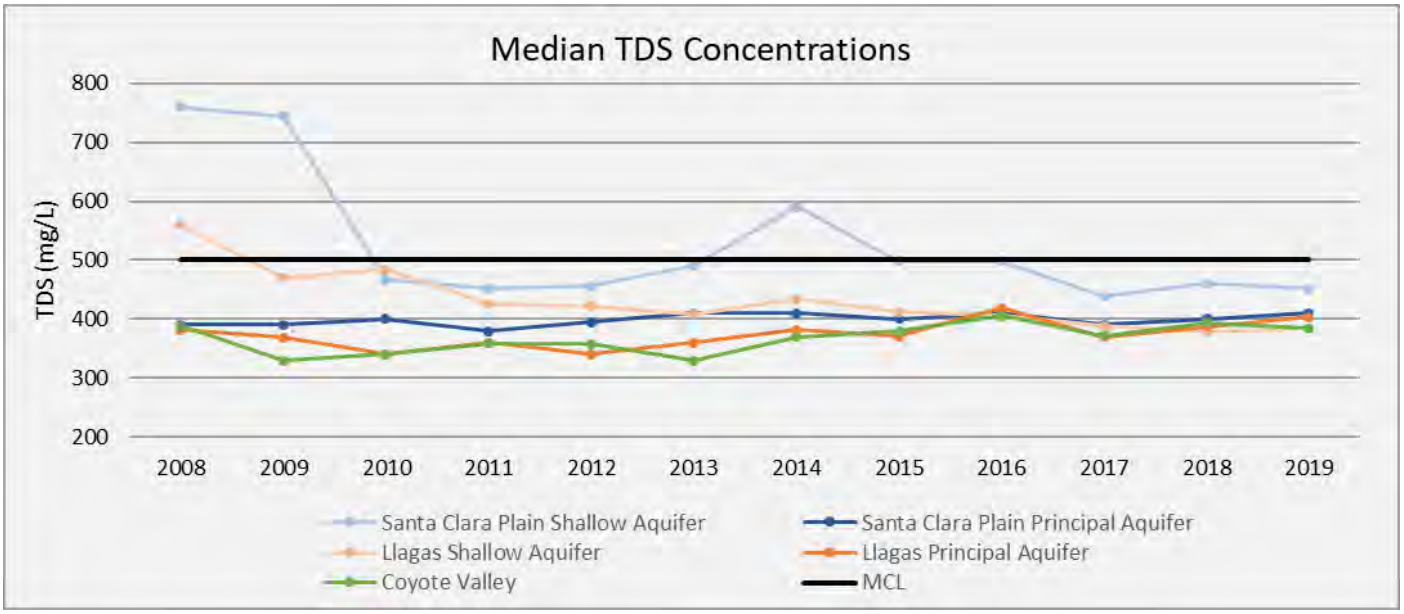


Figure 22. Median Nitrate and TDS by Subbasin and Aquifer Zone (mg/L)





Notes:

1. The shallow and principal aquifer zones are represented by wells primarily drawing water from depths less than and greater than 150 feet below ground surface, respectively.
2. Nitrate as Nitrogen has a health-based MCL of 10 mg/L. TDS has an aesthetic-based MCL, which ranges from 500 to 1,000 mg/L (recommended and upper limit, respectively).
3. Information shown is from monitoring wells, public water supply wells, and domestic wells for which construction information is available. The set of wells sampled each year varies.
4. Median TDS in the Santa Clara Plain shallow aquifer excludes certain wells near San Francisco Bay within the region influenced by salt water interaction.

Comparison to Drinking Water Standards

Except for nitrate, all water supply wells tested, including public and private domestic wells, met all MCLs. Figure 23 shows the locations of water supply wells tested in 2019 with an MCL exceedance.[26] For public water supply wells, 97% met all MCLs, while 74% of all domestic wells met MCLs for the parameters tested (typically fewer parameters compared to public wells).

Nitrate was below its primary MCL of 10 mg/L in 87% of all water supply wells countywide. However, nearly one-fourth of the South County water supply wells tested in 2019 exceeded the nitrate MCL, with 11% of public water supply wells and 28% of domestic wells having at least one result above the MCL. Most detections were from private domestic wells that are not regulated by the state, while seven wells were part of public water systems, which must comply with all drinking water standards. Based on communication with private well owners participating in Valley Water sampling programs, many use bottled water for drinking and cooking, or reverse osmosis treatment to reduce nitrate exposure.

While not used as a source of drinking water, some monitoring wells sampled are screened in the principal aquifer zone. One deep monitoring well in the Llagas Subbasin sampled in 2019 had a nitrate detection above the MCL. Eight shallow aquifer zone monitoring wells in the Llagas Subbasin sampled in 2019 also had nitrate detections above the MCL. Shallow groundwater quality is important, even though it is generally not used as a source of drinking water, because it is a potential water supply source and because shallow groundwater recharges the principal aquifer in recharge areas.

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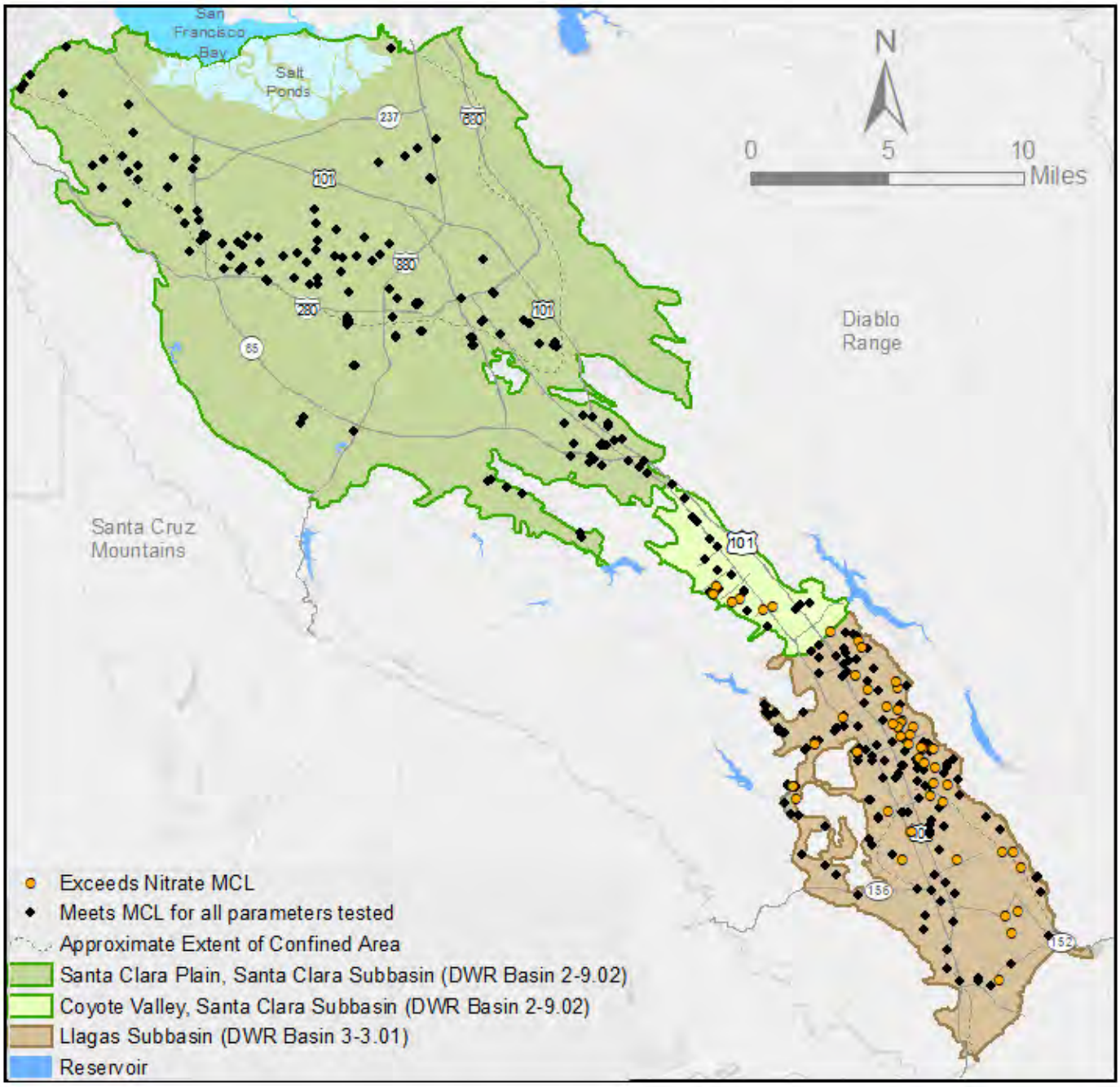
[26] For data obtained from the DDW website, any confirmed result reported above an MCL is considered an exceedance for the purposes of this report. Based on DDW regulations and follow-up sampling, a single detection above an MCL may not constitute a violation of a drinking water standard.

Figure 23. CY 2019 MCL Exceedances at Water Supply Wells



Unregulated Contaminant Monitoring

The U.S. Environmental Protection Agency (EPA) has developed a systematic process for evaluating whether individual chemicals should be regulated to ensure that drinking water poses no significant risk to the public. Every five years, the EPA publishes a list of unregulated compounds to be analyzed in large public water systems through the Unregulated Contaminant Monitoring Rule (UCMR). The EPA uses the UCMR to collect data on contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act. The EPA has completed three rounds of UCMR: UCMR 1 with monitoring between 2001 and

2003, UCMR 2 with monitoring between 2008 and 2010, and UCMR 3 with monitoring between 2013 and 2015. UCMR 3 results for groundwater in Santa Clara County (sampled by water retailers) were summarized in Valley Water's Annual Groundwater Report for 2016. UCMR 4 monitoring will occur between 2018 and 2020 and includes a total of 30 contaminants including cyanotoxins, metals, pesticides and related byproducts, disinfection byproducts, alcohols, and semi-volatile organic chemicals. UCMR 4 sampling results will be evaluated and presented when available through the EPA.

Comparison to Agricultural Objectives

Agriculture in Santa Clara County is largely limited to the Coyote Valley and Llagas Subbasin. South County groundwater quality was evaluated against agricultural water quality objectives from the applicable Regional Water Quality Control Board Basin Plans[27] to assess its suitability. Because Valley Water has limited access to agricultural wells, water supply well data was used in this evaluation. One hundred percent of all South County water supply wells met Basin Plan agricultural objectives.

5.2 Groundwater Quality Trends

To assess changes in water quality over time, chloride, nitrate, and TDS concentrations were evaluated using a variety of techniques over a 15-year period (2005 – 2019) for all groundwater management areas and aquifer zones. Statistical trend tests applied to individual wells required at least five sample results. Trend analysis results show that most wells have stable or decreasing chloride, nitrate, and TDS concentration trends, although some upward trends are observed (Figures 24 through 26 and Table 7). Trend analysis results for each groundwater management area are discussed below.

Santa Clara Plain Shallow Aquifer Zone

Chloride concentration trends are stable or decreasing in most wells (80%) from the Santa Clara Plain shallow aquifer (Table 7). However, geographic coverage in certain areas is limited. Six wells (20%) were identified as having an upward trend. Of the six wells, five show gradual and slowly increasing trends with rates of change ranging between 0.5 and 2 mg/L per year. A much greater change rate is observed at one well influenced by its juxtaposition to an intertidal reach of Guadalupe River. Most of the shallow wells with increasing chloride concentrations are in the area affected by saltwater intrusion. Within the same area, however, are three shallow wells with downward chloride trends.

Nitrate trends in the shallow aquifer zone are all stable or downward. Four wells have downward trends with rates of reduction ranging from 0.05 to 0.37 mg/L per year Nitrate as Nitrogen.

TDS trends are stable or decreasing in most wells drawing from the shallow aquifer zone. Three wells were found to have upward trends, one showing a modest increase of about 10 mg/L per year and two having much greater rates of change. The well with greatest increases in TDS is the same as that previously identified above as having a very steep chloride trend line. No other wells had increasing concentrations of both TDS and chloride.

Santa Clara Plain Principal Aquifer Zone

Most wells in the principal aquifer zone of the Santa Clara Plain (86%) exhibit stable chloride trends. Thirteen percent of wells tested show increasing chloride trends with one well showing a downward chloride trend. Plots of wells having increasing trends show gentle and slowly increasing trends with most having rates of change of less

[27] Groundwater in the Coyote Valley is compared to the "limit" field in Table 3-6 of the San Francisco Bay Basin Water Quality Control Basin Plan (May 2017). Groundwater in the Llagas Subbasin is compared to the upper range of the "increasing problems" range in Table 3-1 and Table 3-2 (irrigation supply) of the Water Quality Control Plan for the Central Coast Basin (June 2019).

than 1 mg/L per year with a few up to about 3 mg/L per year.

Nitrate trends differ substantially from chloride in that many more wells are showing a downward trend (28%). In 62% of wells, no trend is observed. Increasing trends, however, were found in 31 wells (10%) examined. These trends are mostly gradual increases with rates of change estimated between 0.04 and 0.26 mg/L per year nitrate as nitrogen. Downward trends are numerous (67 wells) and most show about the same rate of reduction (~0.1 mg/L per year) with a few exceptions showing more accelerated reduction.

Ninety-three percent of wells tested drawing from the principal aquifer zone do not show any significant change in TDS over the 15-year trend evaluation period. The eight wells (6%) showing increasing trends show rates of change of about 5 mg/L per year, except one well having a rate of about 13 mg/L per year. The location of wells with increasing TDS are shown on Figure 26.

Coyote Valley

Two wells (11%) in Coyote Valley were identified as having an upward chloride trend, while the remainder did not exhibit any trends during the period studied. Wells with upward chloride trends were estimated to be increasing at a rate of about 0.5 and 0.8 mg/L per year.

Most data for Coyote Valley suggest groundwater nitrate levels are unchanging or decreasing during the period examined. Three wells (10%) exhibit slight upward trends with rates of increase ranging from 0.04 to 0.19 mg/L per year Nitrate as Nitrogen with one well stabilizing toward the end of the trend period.

All wells except one indicate TDS concentration is not changing over the study period. The one well with an upward trend has a modest rate of increase estimated at about 6 mg/L per year. Its current TDS concentration is about 380 mg/L. If the rate of change is sustained and remains constant it would take about 20 years for this well to exceed the recommended limit for TDS of 500 mg/L.

Llagas Subbasin Shallow Aquifer Zone

Stable chloride concentrations were found in 62% of wells tested in the shallow aquifer zone. The remainder of wells showed evidence of upward trending concentrations over the period examined, a higher percentage than all other groundwater management areas. No wells showed evidence of decreasing chloride concentrations. Disposal of consumed water via septic systems could explain the greater incidences of upward chloride trends.

In about 75% of wells, nitrate concentrations showed no significant evidence of change over the trend study period. Two wells (12%) showed evidence of increasing concentrations and an equal number with downward trends. One of the wells with increasing nitrate trends shows an abrupt increase in slope around 2012. A linear trend line fitted to the data indicates a rate of change of about 2 mg/L per year nitrate as nitrogen. The other well with an increasing trend has small increases, by comparison, with a rate of change of about 0.1 mg/L per year nitrate as nitrogen.

Three wells were noted as having an increasing TDS trend. TDS concentration trend in one well mirrors that of nitrate as described above as having a sharp increase in slope around 2012. The rate of change is much higher than the other two wells with increasing trends. One well with data only through 2012 indicated a downward trend. The remaining 17 wells did not exhibit any evidence of TDS concentration trend.

Llagas Subbasin Principal Aquifer Zone

In the principal aquifer zone of Llagas Subbasin, 13 wells (24%) showed evidence of increasing concentrations of chloride. Most wells have relatively low concentrations and rates of change less than 1 mg/L per year. Two wells show much greater rates of change (up to 3 mg/L per year). One well was found to have a downward chloride concentration trend. At most wells tested (74%), there was insufficient evidence in the data to assert trend.

Thirty-nine percent of wells indicate downward trending concentrations of nitrate. Fitted trend lines indicate rates of reduction ranging from 0.05 to nearly 0.95 mg/L per year nitrate as nitrogen. Sixty-one percent of wells showed no evidence of changing concentrations. Eight (9%) wells had upward trending concentrations with rates of increase ranging from about 0.04 to 0.24 mg/L per year.

Ninety-six percent of wells in the principal aquifer zone of the Llagas Subbasin show no trend in TDS, two wells have upward trend and no wells have downward trends. Rates of increase of TDS in the two wells are about 7 and 10 mg/L per year as based on fitted trend lines.

All Groundwater Management Areas

The majority of all wells have stable or decreasing concentrations of chloride, nitrate, and TDS. A total of 82%, 91%, and 94% of all wells have stable or decreasing concentrations of chloride, nitrate, and TDS, respectively (Table 7).

Table 7. Chloride, Nitrate, and TDS Concentration Trends (2005 – 2019)

Groundwater Management Area	Parameter	Number of Wells Evaluated	Percent of Wells with Stable Concentrations	Percent of Wells with Decreasing Concentrations	Percent of Wells with Increasing Concentrations
Santa Clara Plain Shallow Aquifer	Chloride	32	70%	10%	20%
	Nitrate (as N)	23	83%	17%	0%
	TDS	29	69%	21%	10%
Santa Clara Plain Principal Aquifer	Chloride	145	86%	1%	13%
	Nitrate (as N)	240	62%	28%	10%
	TDS	143	93%	1%	6%
Coyote Valley	Chloride	18	89%	0%	11%
	Nitrate (as N)	30	63%	27%	10%
	TDS	21	95%	0%	5%
Llagas Subbasin Shallow Aquifer	Chloride	21	62%	0%	38%
	Nitrate (as N)	17	76%	12%	12%
	TDS	21	81%	5%	14%
Llagas Subbasin Principal Aquifer	Chloride	54	74%	2%	24%
	Nitrate (as N)	92	61%	30%	9%
	TDS	54	96%	0%	4%
All Groundwater Management Areas	Chloride	268	80%	2%	18%
	Nitrate (as N)	402	63%	27%	9%
	TDS	268	90%	3%	6%

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Figure 24. Chloride Concentration Trends (2005 - 2019)

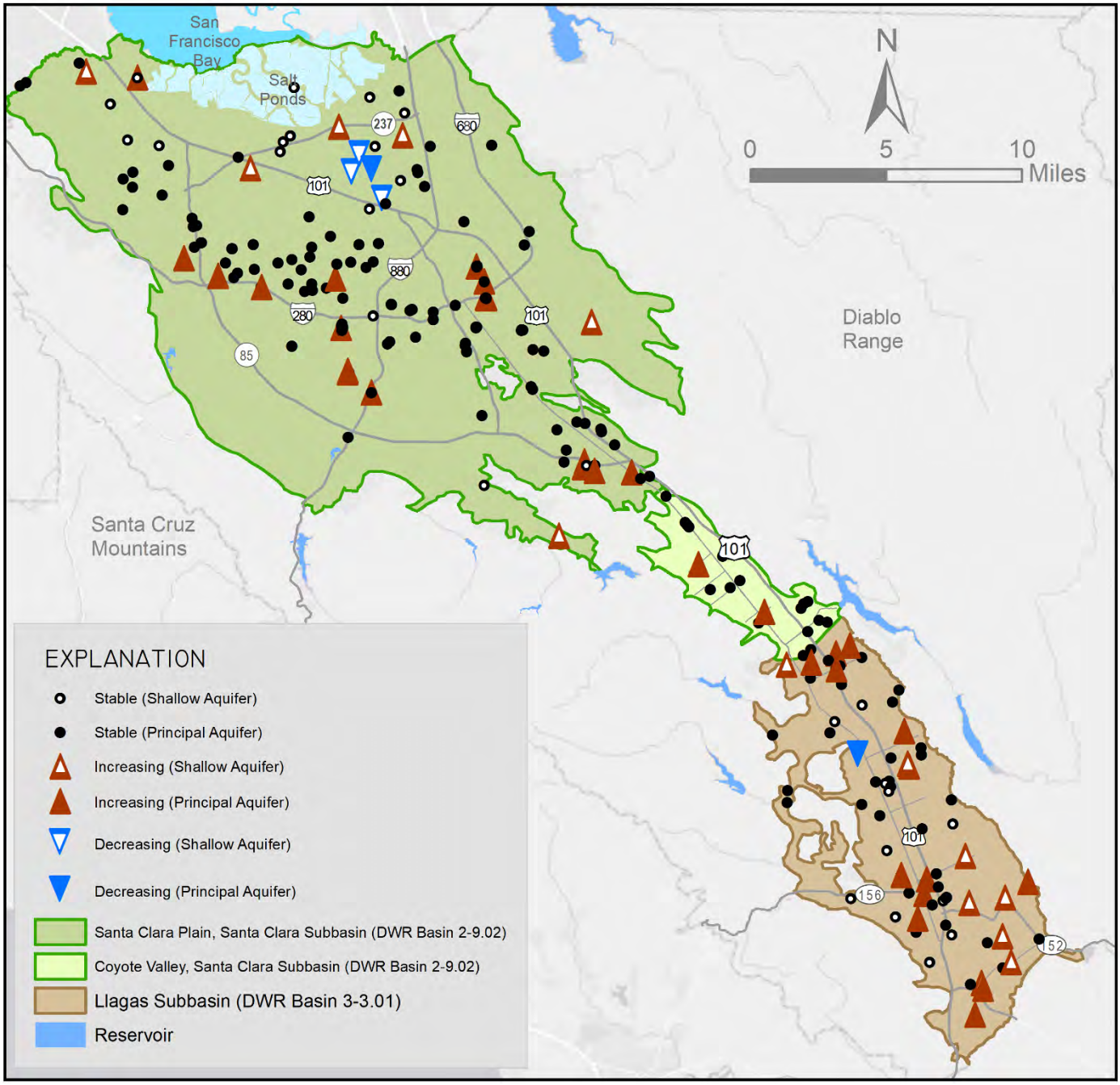


Figure 25. Nitrate Concentration Trends (2005 - 2019)

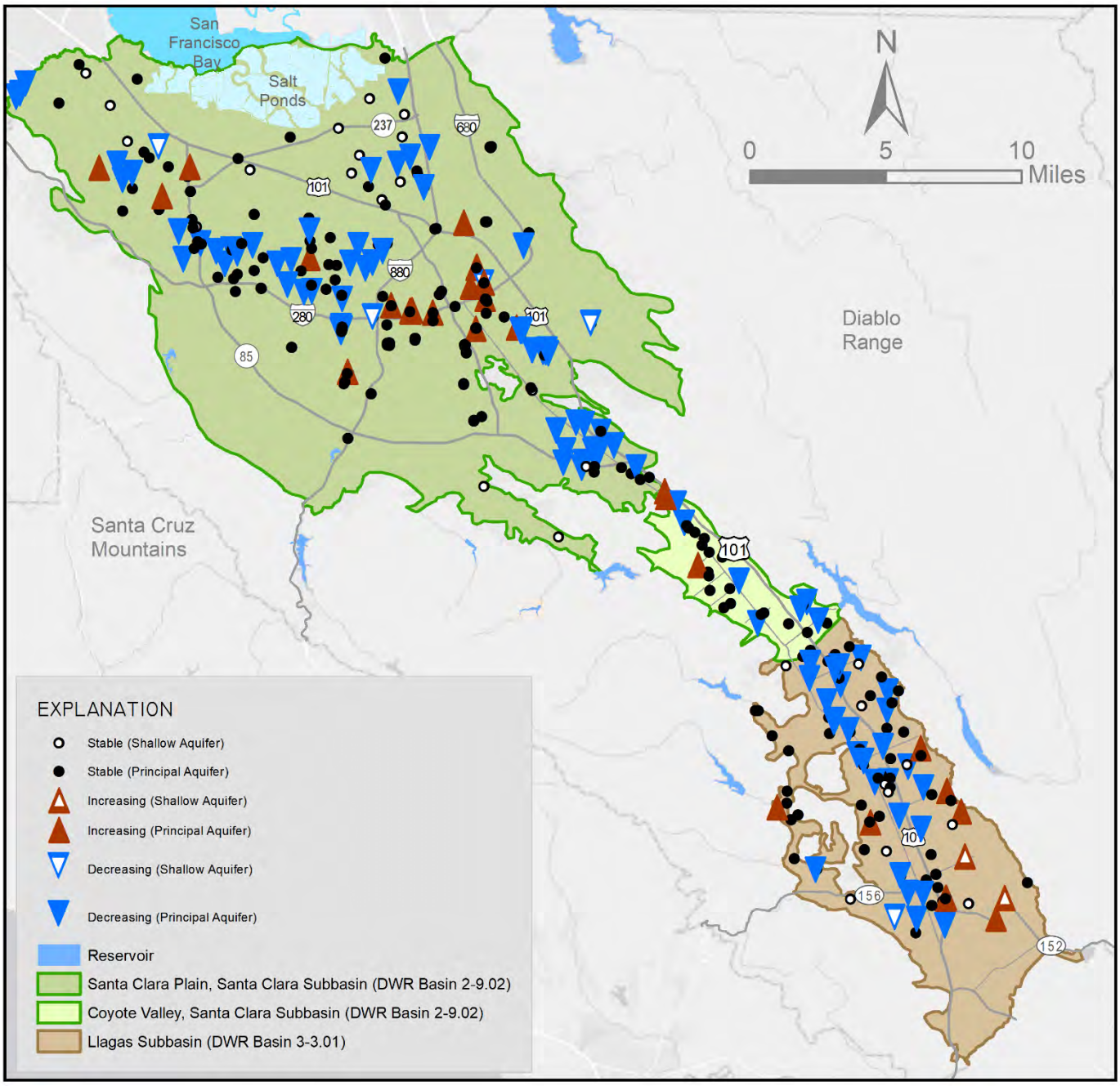
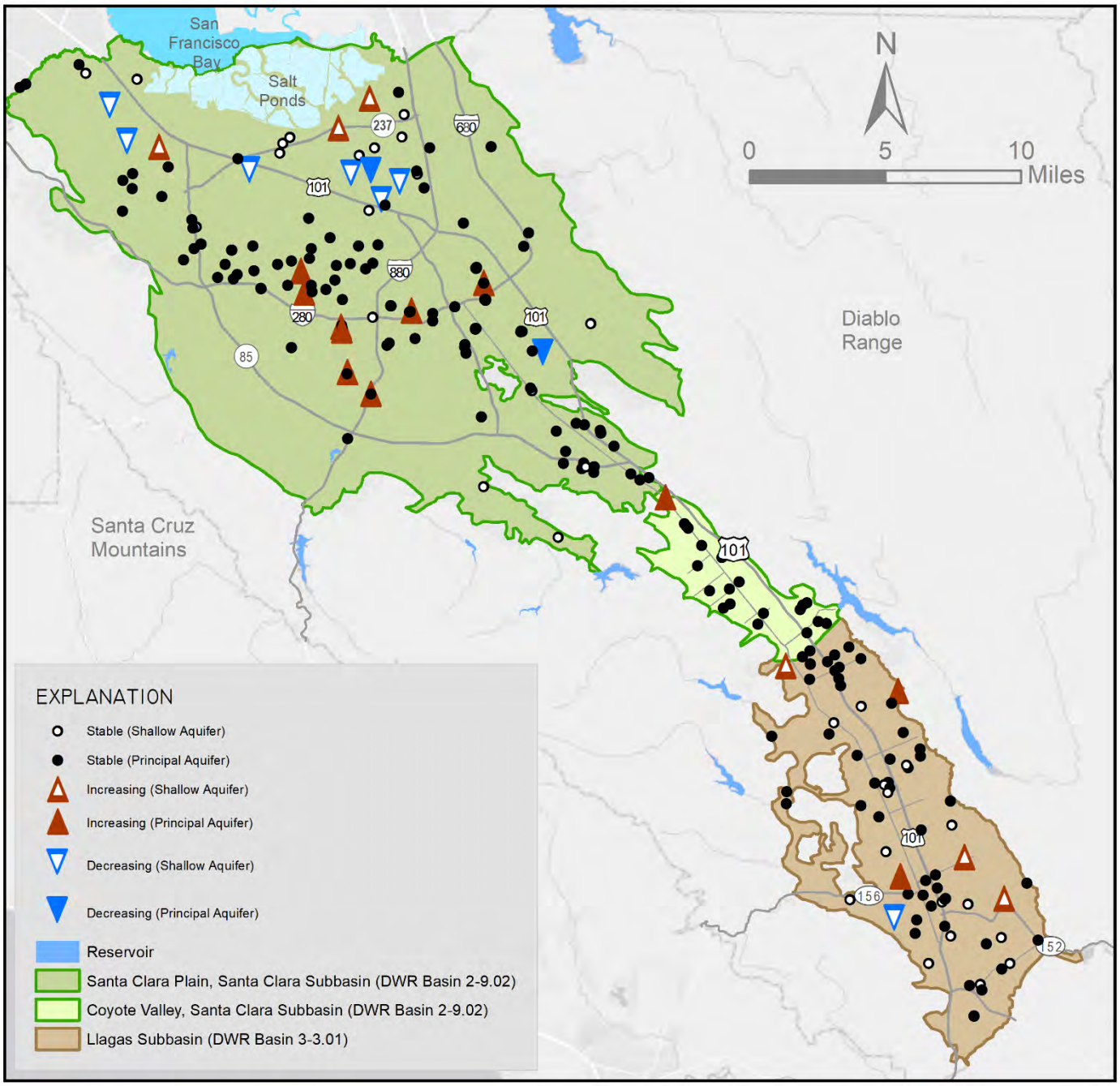


Figure 26. Total Dissolved Solids (TDS) Concentration Trends (2005 - 2019)



Step Trend Analyses

Valley Water also conducted a five, ten, and fifteen-year statistical step trend analysis of nitrate, TDS, and chloride concentrations by groundwater management area for all areas. Differences between data groups is suggestive of changing concentrations within the designated timeframe. Results show no significant change among all groups (Table 8). The highest achieved confidence (~87%) was the 15-year step for chloride in Coyote Valley but was still below the significance level of 95%, using the Mann-Whitney test. The 15-year step trend data sets for nitrate, TDS, and chloride by groundwater management area are represented below using boxplots (Figure 27).

Table 8. Total Dissolved Solids, Nitrate, and Chloride Step Trend Outcome in Principal Aquifers

	5-Year Step Trend[1]	10-Year Step Trend	15-Year Step Trend
Total Dissolved Solids (TDS, mg/L)			
Santa Clara Plain	No Change	No Change	No Change
Coyote Valley	No Change	No Change	No Change
Llagas Subbasin	No Change	No Change	No Change
Nitrate (as Nitrogen, mg/L)			
Santa Clara Plain	No Change	No Change	No Change
Coyote Valley	No Change	No Change	No Change
Llagas Subbasin	No Change	No Change	No Change
Chloride (mg/L)			
Santa Clara Plain	No Change	No Change	No Change
Coyote Valley	No Change	No Change	No Change
Llagas Subbasin	No Change	No Change	No Change

Notes:

1. The median 2019 concentration for each groundwater management area was compared to that of 5 years ago (2014), 10 years ago (2009), and 15 years ago (2004) to determine if there is any statistically significant difference using the Mann-Whitney test at the 95% confidence level.

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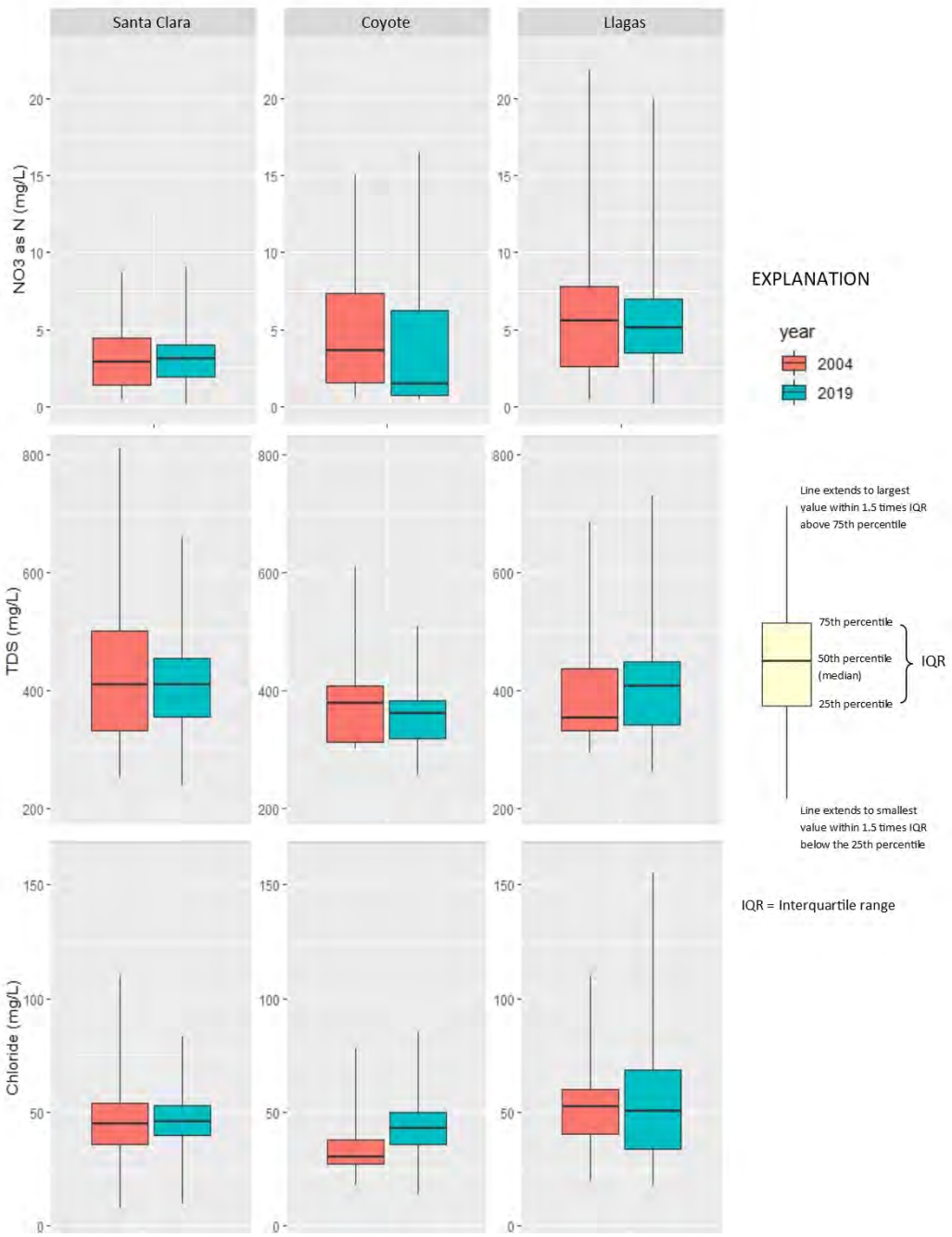
Figure 27. Boxplots Representing Fifteen-year Step Trend Groups by Groundwater Management Area and Trend Parameter



Notes:

1. No significant difference between paired-groups (Mann-Whitney test, 95% confidence).
2. Some outliers present but not all shown within plot y-axis scale

Groundwater and Salt Water Interaction

Salt water intrusion into shallow aquifers was observed historically near South San Francisco Bay and adjacent to the tidal reaches of the Guadalupe River, Coyote Creek, and other creeks in the northern portion of the Santa Clara Plain. The mechanism for this intrusion is not the classic case occurring in coastal aquifers where a wedge of sea water intrudes freshwater aquifers due to a hydraulic connection between groundwater and sea water. San Francisco Bay is a shallow feature (with average depth of 12 to 15 feet) underlain by the Bay Mud, which isolates the Bay from underlying aquifers. The Santa Clara Valley has experienced salt water incursion in streams from brackish water moving upstream, primarily in Coyote Creek and Guadalupe River, and being subsequently infiltrated to shallow aquifers that are not used to supply drinking water. As previously discussed, Valley Water has implemented managed recharge and in-lieu recharge programs to minimize the risk of groundwater overdraft, land subsidence, and salt water intrusion.

Chloride concentrations from shallow monitoring wells are used to assess groundwater and salt water interaction adjacent to southern San Francisco Bay and near tidal reaches of creeks. Valley Water uses a chloride concentration of 100 mg/L as a threshold to indicate that salt water is impacting groundwater. This is a conservative approach since the aesthetic based secondary MCL for chloride is 250 mg/L.

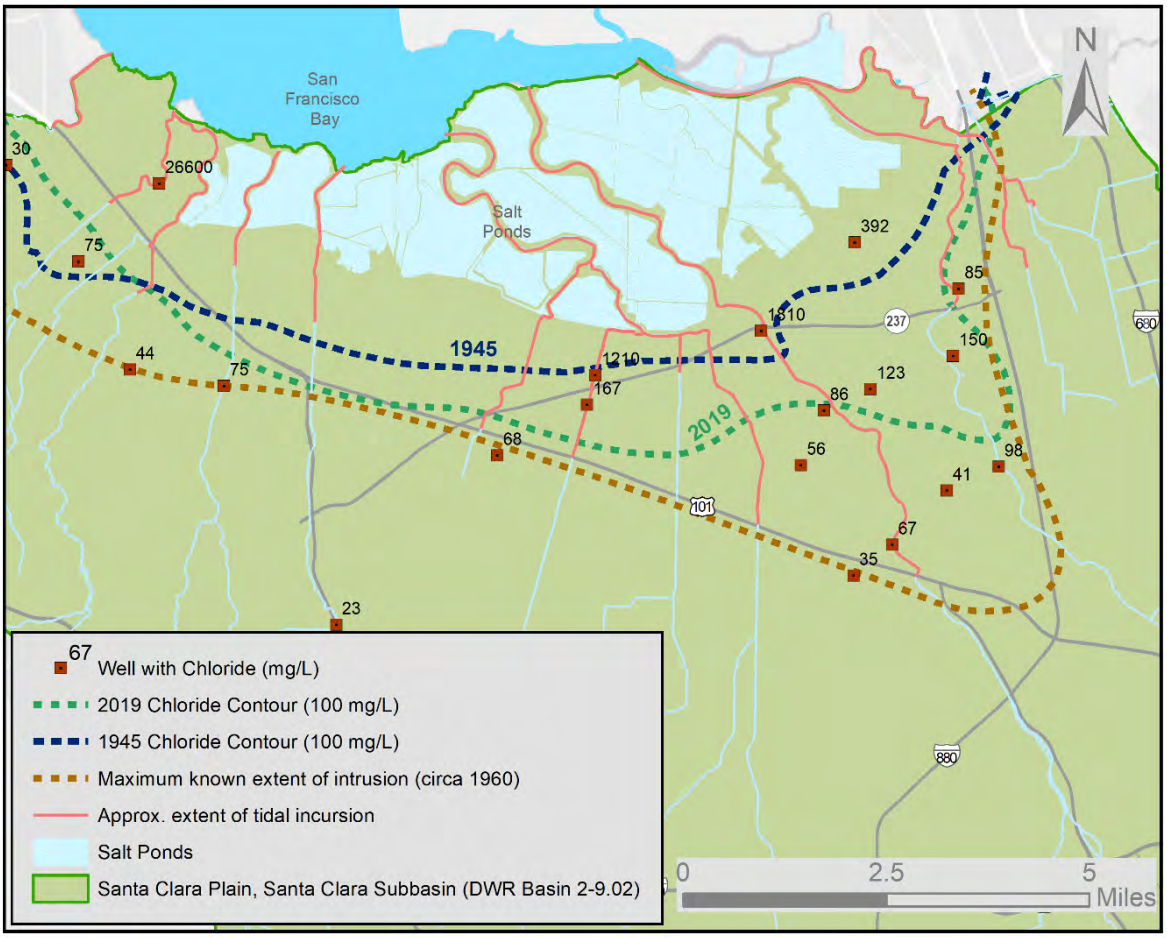
As shown on Figure 28, wells with chloride over 100 mg/L are in a narrow band near the former salt evaporation ponds, except in the areas adjacent to the tidal reaches of creeks (e.g., lower extent of the Guadalupe River and Coyote Creek). In these areas, a larger portion of the shallow aquifer is affected due to tidal influenced salt water incursion in these channels that occurs due to historic land subsidence. The affected area varies slightly from year-to-year. The maximum known extent of salt water intrusion is shown in Figure 28. Most shallow wells in this area have stable or decreasing long-term concentration trends for chloride, demonstrating that the salt water intrusion front appears to be stable or retreating due to improved groundwater conditions.

Few wells in the principal aquifer zone have ever had highly elevated TDS or chloride concentrations. Salt water intrusion into the principal aquifer, though rare, may occur by shallow saline groundwater moving down through vertical conduits, such as abandoned wells, when the vertical hydraulic gradient is downward.[28] At isolated locations in Palo Alto and southeast San Jose, the source of elevated TDS and chloride in deeper wells there has been attributed to connate water (trapped salt water from the geologic past), rather than recent salt water intrusion. Valley Water currently conducts only limited monitoring of the principal aquifer in the Baylands area because few deeper wells are available. Migration of saline shallow groundwater into the principal aquifer has been prevented due to Valley Water's managed and in-lieu recharge activities, which maintain artesian conditions (upward vertical gradient) in the Baylands area.[29] Tidal incursion in the bayward reaches of streams still occurs and it continues to introduce saline water into the shallow aquifer, as the observed elevated and increasing chloride concentration in some shallow aquifer wells in the Baylands area indicate.

[28] Vertical gradients in the Baylands area where salt water interaction occurs have been upward for the last 20 years (approximately).

[29] Artesian conditions are facilitated by the presence of a laterally-extensive clay layer (aquitard), which confines the pressure within the principal aquifer, and isolates the principal aquifer from saline intrusion and other contamination.

Figure 28. Groundwater and Salt Water Interaction in the Santa Clara Plain Shallow Aquifer



5.3 Domestic Well Water Quality

Valley Water offers free, basic water quality testing to domestic well owners within its groundwater benefit zones through the Domestic Well Testing (DWT) program. In 2019, 132 domestic wells in North County and 150 domestic wells in South County were tested through the DWT and annual groundwater sampling programs. Parameters tested include nitrate as nitrogen, fluoride, sulfate, TDS, hardness, bromide, orthophosphate, and bacteria. The number and locations of wells sampled under the DWT program vary by year based on voluntary participation. North County testing included 4 new wells and 11 repeat wells, while South County included 30 new wells and 99 repeat wells. Data from Valley Water's DWT and annual groundwater sampling programs are summarized in this section.

Domestic well testing helps improve Valley Water's understanding of the occurrence of common contaminants and helps private well owners understand their water quality, so they can make informed decisions. Although water quality in domestic wells is not regulated by the state, the comparison to state drinking water standards provides context for interpreting results. When testing domestic wells, Valley Water notifies well owners when any contaminants are present above drinking water standards or when bacteria is present and offers information on additional actions the well owner may wish to take. Table 9 summarizes North County and South County results, including median concentrations and percent of wells with concentrations above drinking water standards.

Nitrate

Of the wells tested, nitrate was not detected above the MCL in any North County domestic well but was detected over the MCL in 40 South County wells. Nitrate results are shown in Figure 29. The median nitrate concentrations in domestic wells in North and South County was 1.4 mg/L and 6.5 mg/L, respectively. The 2019 regional median nitrate concentrations for the principal aquifer in the Santa Clara Plain, Coyote Valley, and Llagas Subbasin (including public water supply wells which are typically deeper) were 3.1, 4.2, and 4.7 mg/L, respectively. Overall, the South County median nitrate concentration for domestic wells is similar to the median nitrate concentration in the Llagas Subbasin.

The continued presence of nitrate above the MCL in many domestic wells in Santa Clara County and many areas of California highlights the need for ongoing efforts by regulatory and land use agencies, agricultural operators, and groundwater management agencies like Valley Water to address elevated nitrate in groundwater. To reduce well owners' exposure to nitrate, Valley Water began implementation of a multi-year rebate program for nitrate treatment systems in the fall of 2013, funded by the Safe, Clean Water and Natural Flood Protection Program (Measure B, a countywide special parcel tax). In 2019, five nitrate treatment system rebates were issued. This effort complements outreach and other efforts to reduce nitrate loading in coordination with the Central Coast Water Board and other basin stakeholders.

TDS

TDS does not have a primary MCL or public health goal, but instead has a secondary MCL, which is based on aesthetic concerns. The secondary MCL for TDS in drinking water is 500 mg/L (recommended), 1,000 mg/L (upper), and 1,500 mg/L (short-term). Of the wells tested, TDS was detected above the recommended secondary MCL in three North County domestic wells and 28 South County domestic wells. One South County domestic well exceeded the upper secondary MCL and the short-term secondary MCL. The median TDS concentrations in domestic wells in North and South County were 383 mg/L and 396 mg/L, respectively. The 2019 regional median TDS concentrations for the principal aquifer in the Santa Clara Plain, Coyote Valley, and Llagas Subbasin were 410 mg/L, 384 mg/L, and 404 mg/L, respectively.

Bacteria

Testing for bacteria included total coliform and Escherichia coli (E. coli), a type of coliform bacteria indicative of fecal contamination. Coliform bacteria are a large family of bacteria naturally present in humans, animals, and the environment and do not normally cause illness, but they should not be present in drinking water. Total coliform bacteria were detected in 29% of the domestic wells tested, a slightly lower percentage than in 2018 (31%), while E. coli was detected in 3% of the domestic wells. Total coliform and E. coli detections appear randomly distributed but are more frequent in the Llagas Subbasin.

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Figure 29. Nitrate Results for Domestic Wells Tested in 2019

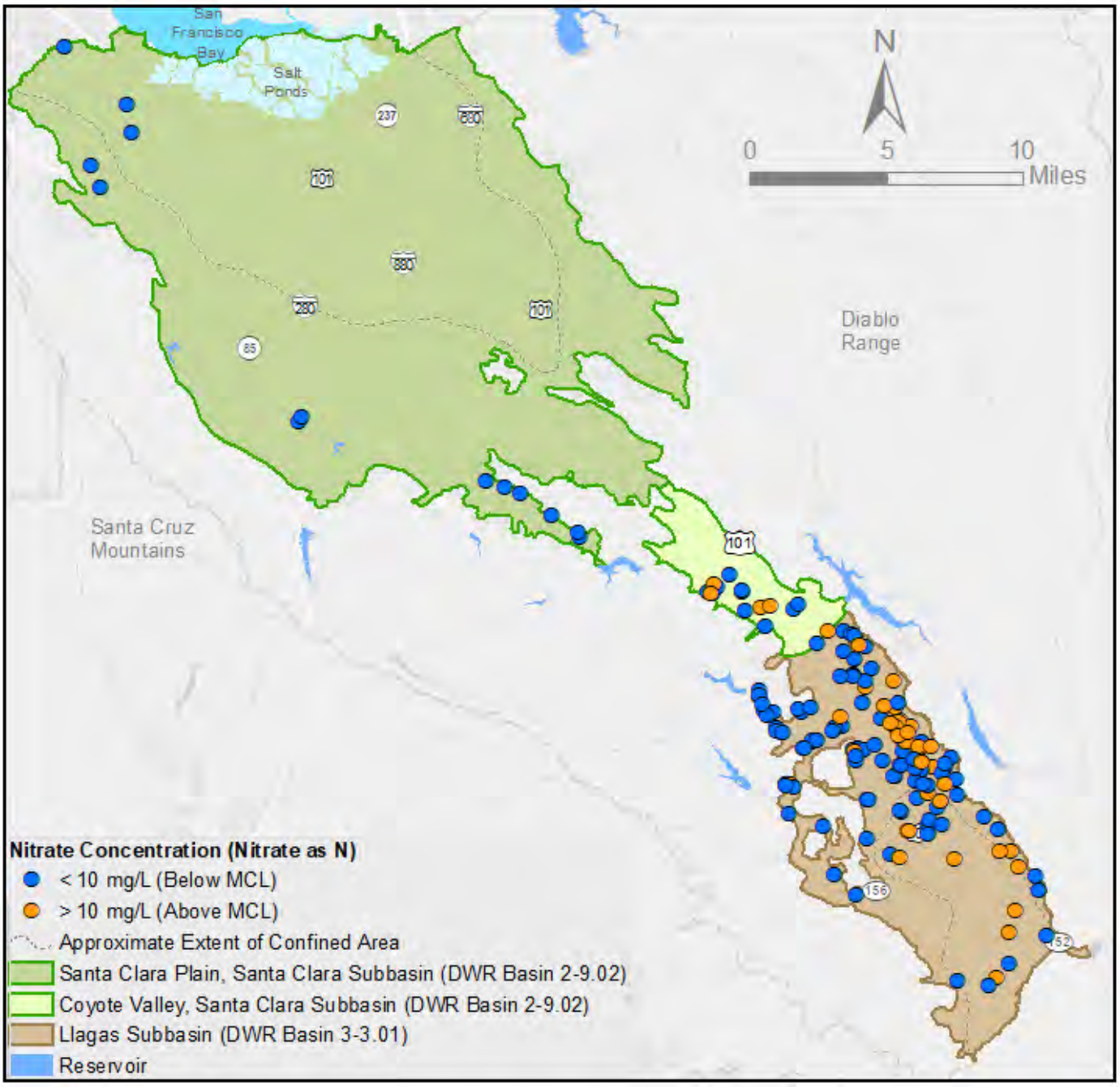

Table 9. 2019 Domestic Well Testing Results

Parameter and Units	MCL[1]	Zone W-2 North County		Zone W-5 South County	
		Median	Wells above MCL[1] (%)	Median	Wells above MCL[1] (%)
Nitrate as N (mg/L)	10 (P)	1.4	0%	6.5	29%
Fluoride (mg/L)	2 (P)	0.12	0%	0.13	0%
Sulfate (mg/L)	250 (S)	43	0%	37	0%
Total Dissolved Solids (mg/L)	500 (S)	383	21%	396	20%
Hardness (mg/L as CaCO3)	--	266	--	269	--
Bromide (mg/L)	--	0.2	--	0.19	--
Orthophosphate (mg/L as PO4)	--	<0.1	--	<0.1	--
		Wells with Bacteria Present (No.)	Wells with Bacteria Present (%)	Wells with Bacteria Present (No.)	Wells with Bacteria Present (%)
Total Coliform Bacteria	--[2]	4	33%	40	29%
E. Coli Bacteria	--[2]	0	0%	5	4%

Notes:

1. Maximum contaminant levels are established by the DDW for public water systems. (P) indicates the parameter has a health-based Primary MCL and (S) indicates a Secondary, aesthetic-based MCL. Hardness does not have a primary or secondary MCL but water with hardness above 180 mg/L is classified as very hard. Water quality in domestic wells is not regulated by the state.
2. Bacteria are measured as present or absent. Public water systems are required to ensure that fewer than 5% of samples have total coliform present and that no samples have E. Coli present.

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5.4 Recharge Water Quality

The Recharge Water Quality Monitoring Program (RMP) was developed to monitor water quality at selected groundwater recharge facilities in the Santa Clara and Llagas Subbasins. The primary objective of the RMP is to characterize recharge water quality and assess the need for changes to groundwater monitoring and/or recharge programs to ensure adequate groundwater protection.[30] Recharge facilities (percolation ponds and managed reaches of creeks) receive a combination of local runoff and imported water. The ratio of local runoff to imported water varies throughout the year and between years, depending on hydrological conditions.

Monitoring is conducted in accordance with the Valley Water's 2016 GWMP, which prescribes sampling facilities within each recharge system every three years. Recharge systems selected for monitoring are typically sampled in May, July, and September to best characterize the water quality of water used for recharge operations, which are generally implemented during the dry season (April through October). Basic water quality parameters are monitored, including major and minor inorganics, anions, nutrients, TDS, total alkalinity, and field parameters (e.g., pH, dissolved oxygen, temperature). Organic parameters (e.g. herbicides, pesticides, and disinfection byproducts) are monitored at a subset of recharge facilities that are located near potentially contaminating activities such as industrial areas and highways.

In 2019, Valley Water monitored a total of fifteen recharge facilities that comprise three recharge systems: Coyote, Los Gatos, and West Side (Figure 30, Table 10).[31]

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[30] Recharge Water Quality Monitoring Plan. September 2012. Groundwater Monitoring and Analysis Unit, Santa Clara Valley Water District.

[31] The Penitencia, Los Gatos, and Guadalupe recharge systems were scheduled to be sampled in 2019 but ponds in the Penitencia and Guadalupe system were not operated due to very healthy groundwater conditions, so West Side and Coyote were chosen for sampling instead.

Table 10. 2019 Recharge Water Quality Sampling Locations

Recharge System	Facilities Sampled in May, July, and September 2019
Coyote	• Coyote Creek: near Singleton Rd and Tuers Rd in San Jose • Coyote Creek: near Blossom Hill Rd and Hwy 101 in San Jose • Coyote Pond North: near Metcalf Rd and Old Monterey Rd in San Jose • Coyote Pond South: near Metcalf Rd and Old Monterey Rd in San Jose • Coyote Creek: near Coyote Ranch Rd and Old Monterey Rd in San Jose • Coyote Creek: near Bailey Ave and Hwy 101 in San Jose • Coyote Creek: near Barnhart Ave and Old Monterey Rd in Morgan Hill
Los Gatos	• Los Gatos Creek: near Dell Ave and Vandell Way in San Jose • Los Gatos Creek: near Dell Ave and Lost Lake Ln in San Jose • Los Gatos Creek: near Gilman Ave and E. Campbell Ave in Campbell • Los Gatos Creek: near S. Bascom Ave and E. Campbell Ave in San Jose • Los Gatos Creek: near Meridian Ave and McKinley Ave in San Jose • Los Gatos Creek: near Pedro St and Lincoln Ave in San Jose
West Side	• Stevens Creek: near Foothill Rd and I-280 in Cupertino • Stevens Creek: near Stevens Creek Blvd and Scenic Blvd in Cupertino • Stevens Creek: near McClellan Rd and Club House Ln in Cupertino

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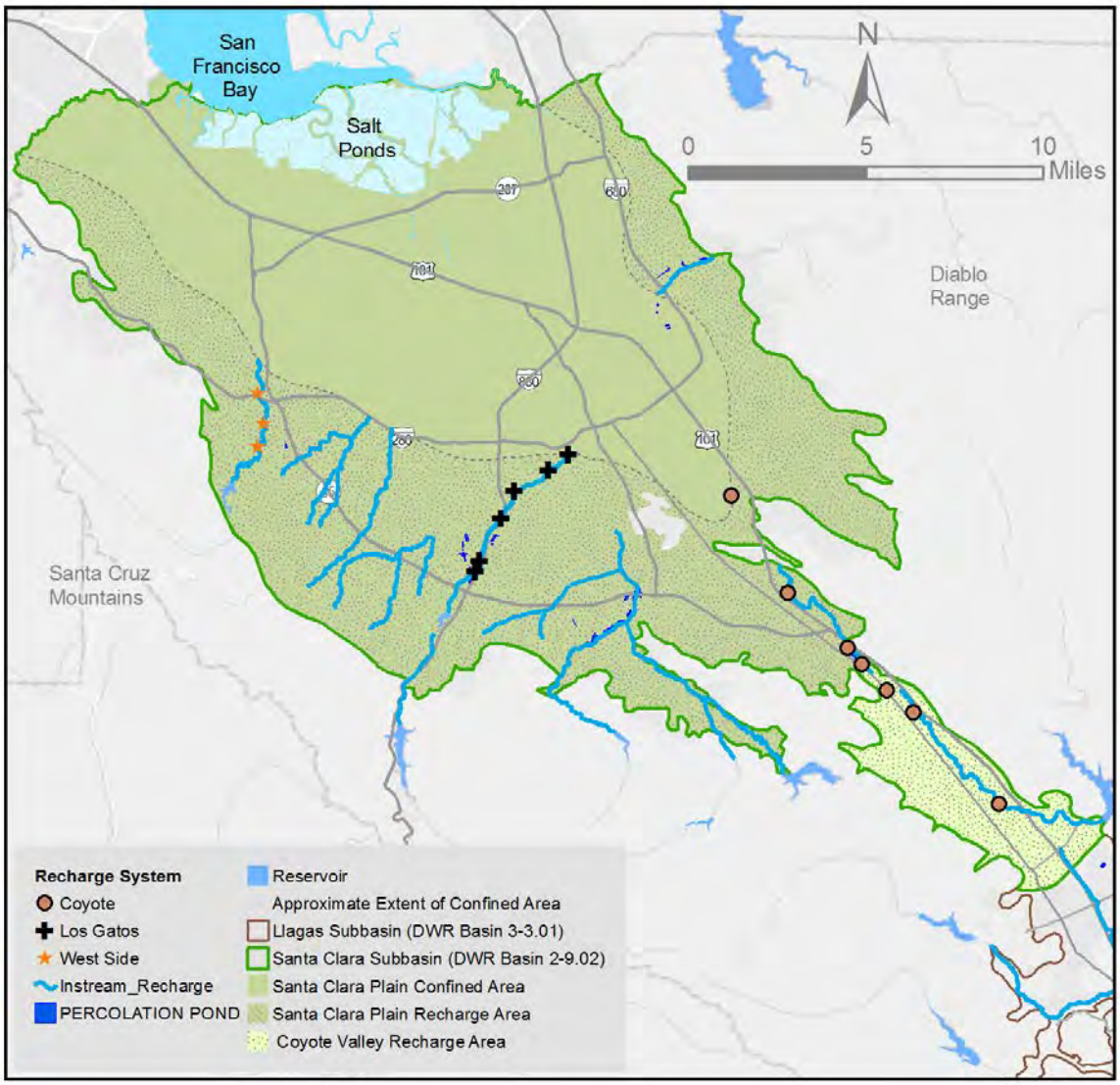
Figure 30. Location of 2019 Sampling Sites in the Coyote, Los Gatos, and West Side Recharge Systems



Although managed recharge water is not suitable for direct consumption before treatment or infiltration, comparing it to drinking water standards provides context for results. No parameters were detected above health-based water standards in any of the recharge water samples collected. Table 11 provides water quality indicators for salinity, non-point source pollution, and trace metals. Results are compared against median groundwater quality indicators for the corresponding groundwater subbasin area (Table 11). Organic parameters were not detected at any facilities in which they were monitored. In summary, recharge water quality is generally of equal or better quality than receiving water (local surface waters and groundwater) and there are no water quality concerns for the parameters tested.

Table 11. Summary of Key Water Quality Indicators for All Recharge Systems Sampled in 2019

Parameter	Units	Coyote System Median[1]	Los Gatos System Median[1]	West Side System Median[1]	MCL[2]	SMCL[2]	2019 Regional Groundwater Median[3]	
							Santa Clara Plain	Coyote Valley
Aluminum	ug/L	<20	<20	<20	1,000	200	25	20.5
Chloride	mg/L	31	11	17	N/A[6]	250	46	43
Iron	ug/L	<20	<20	<20	N/A	300	22.3	<20
Nitrate (as N)	mg/L	1.75	<0.1	0.2	10	N/A	3.1	4.2
Organics[4]	ug/L	ND[5]	ND	ND	varies	N/A	N/A	N/A
pH	pH units	7.83	8.01	7.75	N/A	6.6-8.5	7.6	7.4
Sulfate	mg/L	50.1	32.35	35.7	N/A	250	44	41.6
TDS	mg/L	320	205	324	N/A	500	410	384
Total Alkalinity (as $CaCO_3$)	mg/L	171	121	212	N/A	N/A	240	265

Notes:

1. Medians are calculated from measurements taken in May, July, and September for the stations noted in Table 11.
2. Although managed recharge water is not suitable for direct consumption before treatment or infiltration, comparing it to drinking water standards provides context for results.
3. 2019 median for principal zone of the Santa Clara Plain and Coyote Valley.
4. Organic parameters were measured using EPA Method 524.2 for Volatile Organic Compounds (VOCs) and EPA Method 525.2 for Semi-Volatile Organic Compounds (Semi-VOCs).
5. ND = non-detect (detection limits vary depending on parameter).
6. N/A = not applicable

5.5 Monitoring Near Recycled Water Irrigation Sites

Valley Water partners with the four recycled water producers[32] in Santa Clara County to provide tertiary-treated disinfected recycled water (recycled water) for non-potable purposes such as landscape irrigation, agricultural irrigation, and industrial uses. Recycled water used in Santa Clara County generally has higher concentrations of salts, nutrients, disinfection byproducts, and emerging contaminants than local groundwater or imported water.[33] Previous studies have shown that some contaminants in recycled water can migrate to shallow groundwater as a

[32] Recycled water is produced at the Palo Alto Regional Wastewater Quality Control Plant (PARWQCP), the Sunnyvale Water Pollution Control Plant (SWPCP), the San Jose/Santa Clara Regional Wastewater Facility (SJSCRWF), and the South County Regional Wastewater Authority (SCRWA). The branch of the SJSCRWF that produces recycled water is referred to as South Bay Water Recycling (SBWR).

[33] *Advanced Recycled Water Treatment Facility Project*. Black & Veatch and Kennedy/Jenks for the Santa Clara Valley Water District. August, 2003.

result of recycled water irrigation.[34,35] To ensure groundwater resources remain protected as recycled water use expands, Valley Water has monitored groundwater near areas irrigated with recycled water at the Integrated Device Technology (IDT) facility in the Santa Clara Subbasin where recycled water is provided by South Bay Water Recycling (SBWR) and monitors numerous sites in the Llagas Subbasin where recycled water is provided by the South County Regional Wastewater Authority (SCRWA). Valley Water also receives groundwater data from SBWR, which monitors groundwater near sites irrigated with recycled water in the Santa Clara Subbasin. If evidence shows that recycled water irrigation is adversely affecting groundwater, actions may be taken to mitigate the deleterious effects.

Groundwater from the four wells at the IDT facility was not monitored in 2019 due to the expiration of the monitoring agreement between Valley Water and IDT, which was developed as a mitigation measure for the use of recycled water at the site. During the ten years the IDT wells have been monitored, low levels of parameters related to recycled water have been detected but not at levels that warrant a recommendation to develop a corrective action plan or to discontinue recycled water irrigation. For example, two categories of compounds known as wastewater indicators (and contaminants of emerging concern, (CECs)), nitrosamines and Per- and Polyfluoroalkyl Substances (PFAS), have occasionally been detected at low levels in the IDT wells. Nitrosamines and PFAS are present at much higher concentrations in the recycled water delivered to the IDT facility. Results from groundwater monitoring of the IDT wells demonstrate that, in general, groundwater quality is not changing significantly over time.[36] Valley Water is exploring the possibility of continued monitoring at the IDT facility to complement groundwater monitoring data received from SBWR.

The 2019 recycled water sampling events are summarized in Table 12. More detailed monitoring results are presented in Appendix E. Geochemical evaluations and statistical analyses of long-term concentration trends are used to evaluate water quality impacts of recycled water irrigation, summarized below for the Santa Clara Plain (there is no recycled water irrigation in Coyote Valley) and the Llagas Subbasin.

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[34] *Fate and Transport of Wastewater Indicators: Results from the Ambient Groundwater and from Groundwater Directly Influenced by Wastewater*. California GAMA Program, Lawrence Livermore National Laboratory and California State Water Resources Control Board. June, 2006.

[35] *Recycled Water Irrigation and Groundwater Study: Santa Clara and Llagas Groundwater Subbasins*. Locus Technologies for Valley Water. August, 2011.

[36] *Annual Groundwater Report for Calendar Year 2018.* Valley Water. In progress.

Table 12. Summary of 2019 Groundwater Monitoring Events near Recycled Water Irrigation Sites

Subbasin	Location	Sampling Agency	Sampling Summary
Santa Clara Subbasin (Santa Clara Plain)	Various Locations in San Jose	South Bay Water Recycling (SBWR)	• Groundwater from six shallow wells and four deep wells was monitored in February 2019 by the City of San Jose per their Groundwater Mitigation and Monitoring Plan (GMMP)
Llagas Subbasin	Christmas Hill Park, Gilroy	Valley Water	• Groundwater from three shallow wells was sampled in March and September 2019 • Recycled water delivered to this site was sampled in March and September 2019
	Irrigated Land Near SCRWA Plant, Gilroy	Valley Water	• Groundwater from three shallow wells and one deep well was sampled in March and September 2019 • Recycled water delivered to the site from the SCRWA plant was sampled in March and September 2019
	Irrigated Land Along Expanded Recycled Water Pipelines (West Gilroy)	Valley Water	• Groundwater from 12 shallow monitoring wells was sampled in March 2019 and groundwater from 10 shallow wells was sampled in September 2019.

Santa Clara Subbasin

SBWR developed a Groundwater Monitoring and Mitigation Program (GMMP) in order to meet the terms of the 1997 Environmental Impact Report (EIR) for the SBWR system expansion.[37] SBWR has monitored groundwater wells in areas near recycled water irrigation since 1997. The groundwater wells monitored by SBWR consist of four (previously six; two wells were destroyed in 2018) deep groundwater supply wells and six shallow groundwater monitoring wells (Figure 31). These ten wells are referred to as "GMMP wells." The primary parameters of concern identified in the EIR were salts (measured as TDS-) and nitrate; hence, the list of monitoring parameters for the GMMP wells is less extensive than the list of monitoring parameters used by Valley Water for the IDT wells in the past and for the South County wells (described under Llagas Subbasin section). The GMMP does not include analyses for wastewater indicators such as PFAS or nitrosamines, making it more challenging to assess recycled water impacts to groundwater.

Valley Water and SBWR have worked to improve recycled water quality for irrigation and other purposes. Since March 2014, recycled water provided by SBWR has been blended with advanced treated water from Valley Water's Silicon Valley Advanced Water Purification Center, which produces up to eight million gallons of water a day. The final, blended recycled water quality is improved, with TDS lowered from about 750 mg/L to about 500 mg/L.

Concentration Trends

Concentration trend results for the deep GMMP wells show increasing trends for calcium, chloride, magnesium, and nitrate in the majority of wells (Table 13). TDS and sulfate concentrations each show increasing trends for two of the deep wells (Table 13). These concentration trend results may be due to recycled water irrigation but may also be due to other factors such as lateral movement from the recharge area into the interior of the Santa Clara Plain.

Concentration trend results for the shallow GMMP wells show increasing trends for calcium, chloride, magnesium, potassium, and sodium in the majority of wells (Table 13). These increasing concentration trends may be due to

[37] *GMMP EIR*. Harding Lawson Associates for the City of San Jose. 1997

recycled water irrigation; however, the lack of data collection of wastewater indicators makes it more difficult to determine the role recycled water irrigation plays in these trends.

Table 13. Groundwater Concentration Trends at Santa Clara Plain Recycled Water Irrigation Sites

Parameter	Number of Wells with Increasing Concentrations	Number of Wells with Stable Concentrations	Number of Wells with Decreasing Concentrations
Bicarbonate	2	5	3
Calcium	8	1	1
Chloride	7	3	0
Magnesium	8	1	1
Nitrate	4	2	4
Potassium	5	4	1
Sodium	6	2	2
Sulfate	5	2	3
Total Dissolved Solids (TDS)	5	3	2

Geochemical Analyses

Geochemical analyses were completed using Piper Diagrams, a graphical tool for understanding sources of dissolved parameters in water, water quality trends over time, and whether mixing between two water sources has occurred. Piper Diagram analysis suggests that mixing between groundwater and recycled water is not evident in samples collected from the four deep wells in 2019. Results for the six shallow GMMP wells in 2019 are inconclusive and suggest multiple geochemical processes are in progress, including the possibility of recycled water mixing with groundwater.

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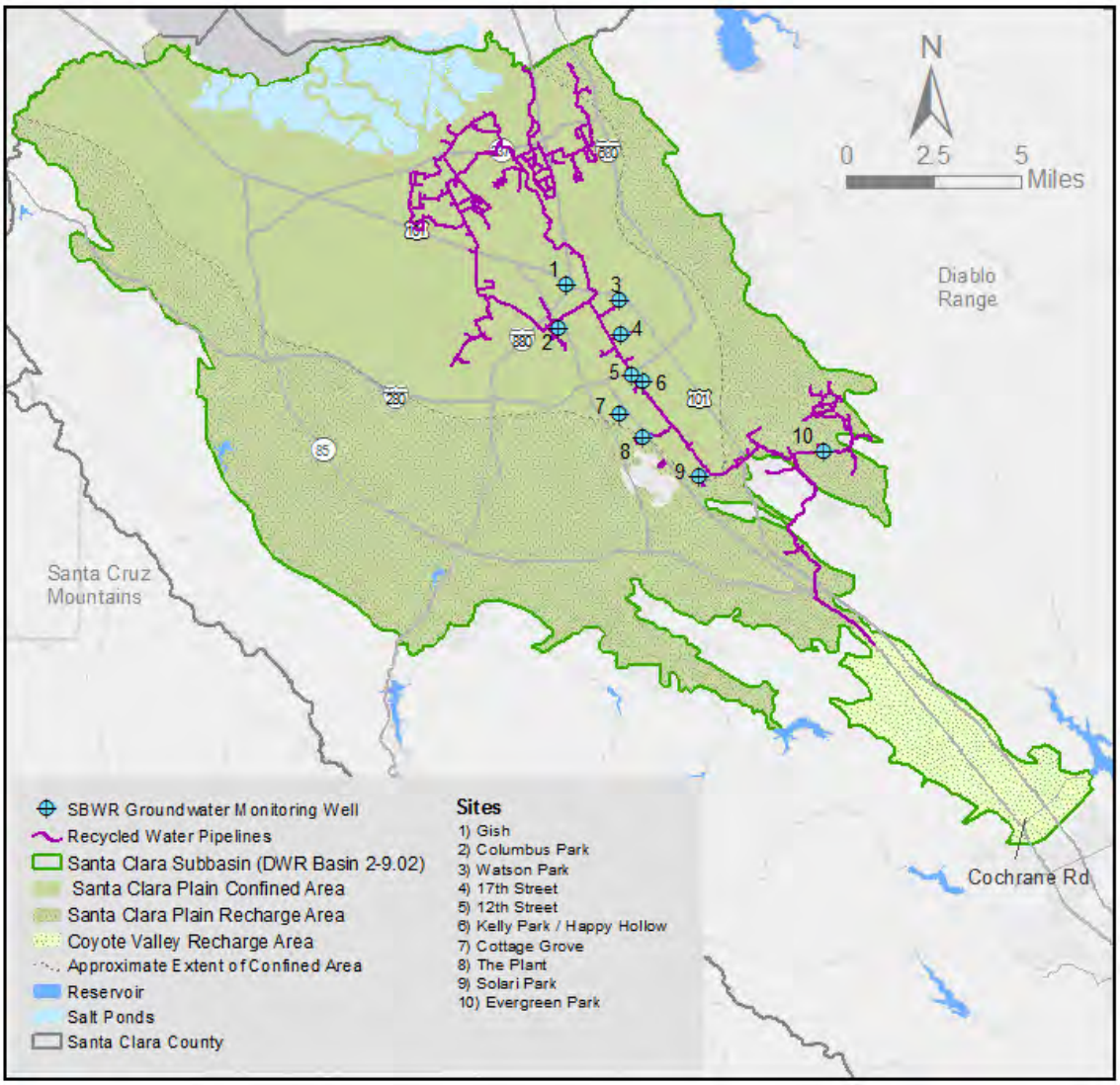
Figure 31. Groundwater Monitoring Near Santa Clara Subbasin Recycled Water Irrigation Sites



Llagas Subbasin

To support expanded recycled water use per the *South County Recycled Water Master Plan*[38] and to comply with the terms of the *Final Program EIR for the South County Recycled Water Master Plan*[39], Valley Water developed the *South Santa Clara County Recycled Water/Groundwater Monitoring Plan* (SCP) in 2012 and began collecting samples from a group of groundwater monitoring wells located along the SCRWA pipelines and at the SCRWA facility.[40] Additional groundwater monitoring wells were added to the SCP as SCRWA expanded its recycled water system; all wells monitored by Valley Water as part of the SCP are referred to as "South County wells" (Figure 32). Valley Water analyzes South County well water samples for basic water quality parameters, disinfection by-products, nitrosamines, PFAS, and other parameters commonly encountered in recycled water.

[38] *South County Recycled Water Master Plan.* Carollo Engineers for Valley Water and South County Regional Wastewater Authority. October, 2004.
[39] *Final Program EIR for the South County Recycled Water Master Plan.* Valley Water. March, 2011.
[40] *South Santa Clara County Recycled Water/Groundwater Monitoring Plan*. Valley Water. June, 2012.

Wastewater Indicators

Four of the South County wells are located near the SCRWA facility. These four wells (three shallow wells and one deep well) are near farmlands irrigated with recycled water and are also near sludge-drying ponds that receive secondary effluent produced at the SCRWA facility. Nitrosamines and PFAS have been more frequently detected, and at higher concentrations, in the four wells near the SCRWA facility than in other South County wells. This suggests an impact of recycled water, secondary effluent from the sludge-drying ponds, or both, on groundwater near the SCRWA facility.

Two PFAS measured in the South County wells, perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS), have notification levels (NLs) that have been set by the California State Water Resources Control Board at 5.1 nanograms per liter (ng/L) for PFOA and 6.5 ng/L for PFOS.[41] The NLs for PFOA and PFOS apply only to water used for drinking; while water from the South County wells is not used for drinking, the NLs provide a useful reference point with which to compare PFOA and PFOS levels. In 2019 PFOA was detected above the NL in nine South County monitoring wells, four of which are wells located at the SCRWA facility. The median value for PFOA for all South County wells is non-detect (i.e. less than 5 ng/L). However, the median value for PFOA for the nine wells in which it was detected above the NL is 12 ng/L, considerably higher than the NL for PFOA. The four monitoring wells located at the SCRWA facility have the highest levels of PFOA, ranging from 19 ng/L to 59 ng/L.

In 2019 PFOS was detected above the NL in six South County wells, four of which are wells located at the SCRWA facility. While the median value for PFOS for all South County wells is non-detect (i.e. less than 5 ng/L), the median value for PFOS for the six wells in which it was detected above the NL is 41 ng/L. This is significantly above the NL and higher than the response level (RL) of 40 ng/L. The four monitoring wells located at the SCRWA facility have the highest levels of PFOS, ranging from 17 to 96 ng/L.

While PFOA and PFOS have been consistently detected in South County and IDT wells over the years, these parameters have not been regularly measured as part of other Valley Water groundwater monitoring programs. Recently, Valley Water began a preliminary PFAS sampling program to sample up to 60 groundwater wells located throughout Santa Clara County. Data from this PFAS sampling program will allow for comparison with data gathered from the South County and IDT wells and will also provide a broader geographical view of the extent of PFAS (including PFOA and PFOS) distribution; results from the preliminary PFAS sampling program may lead to additional sampling or identify action(s) needed.

In 2019 N-Nitrosodimethylamine (NDMA) was detected in recycled water from SCRWA at levels ranging from 2.2 to 3.4 ng/L. These values are only slightly above the detection limit of 2 ng/L. NDMA was detected in three South County wells in 2019; levels ranged from 3.1 ng/L to 4.7 ng/L. For a point of reference, the NL for NDMA for drinking water is 10 ng/L. NDMA has been periodically detected at South County wells in the past.

While not specifically a recycled water or wastewater indicator, TDS values are generally higher in recycled water (and wastewater) than in local groundwater; the median TDS value for 2019 for recycled water produced by SCRWA is 729 mg/L while the regional TDS for 2019 for local groundwater from the Llagas Subbasin is 384 mg/L for the shallow aquifer and 404 mg/L for the principal aquifer. The four wells located onsite at SCRWA (plus one nearby well) have a median TDS value of 670 mg/L which is significantly higher than the median TDS value of all other South County wells, 298 mg/L. This suggests an influence of secondary effluent from the sludge-drying ponds (at SCRWA) on TDS values in nearby wells. The median TDS value of all other South County wells (of 298 mg/L) is consistent with median TDS values for the principal and shallow Llagas aquifers.

[41] State Board citation

Concentration Trends

The majority of South County wells show stable or decreasing trends for all parameters (Table 14). Chloride, potassium, and sodium have increasing trends for four, six, and five wells, respectively (Table 14). Most of the South County wells with increasing concentration trends were either located at the SCRWA facility or at Christmas Hill Park in Gilroy, which was one of the first sites to receive recycled water from SCRWA for irrigation (recycled water irrigation at Christmas Hill Park began in 2003). It is possible that these increasing concentration trends at Christmas Hill Park are due to recycled water irrigation; however, as noted below, geochemical analyses suggest that ionic composition of the three Christmas Hill Park wells is more similar to local groundwater than to recycled water.

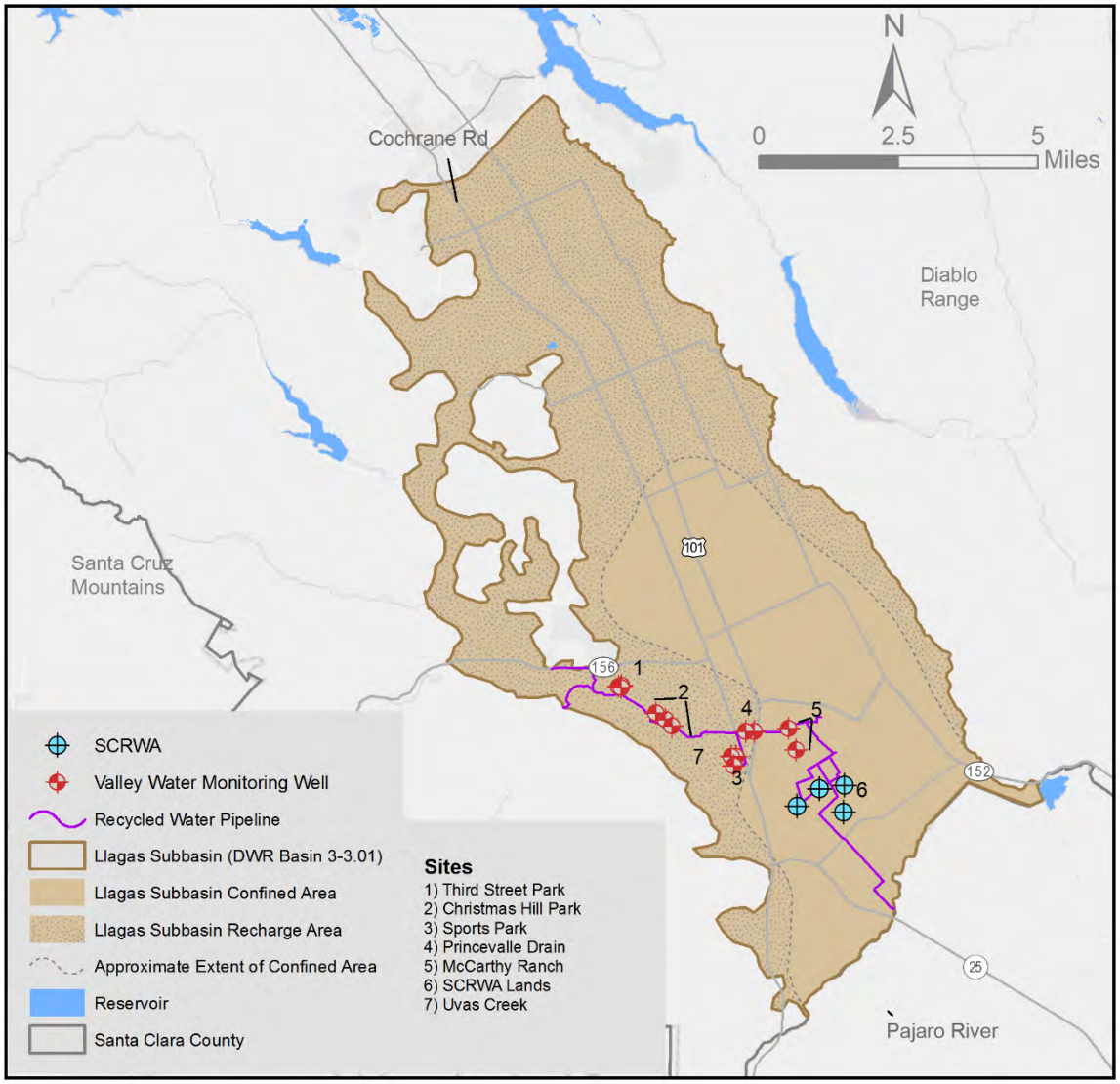
Geochemical Analyses

Geochemical analyses completed using Piper Diagrams show that the ionic composition of the three shallow wells near the SCRWA facility is almost identical to recycled water which could be due to recycled water irrigation on the nearby farmlands but could also be due to percolation of secondary effluent from the SCRWA sludge-drying ponds. Geochemical analyses of all other South County wells show ionic compositions more similar to local groundwater (than to recycled water) and do not appear to be changing significantly over time.

Table 14. Groundwater Concentration Trends at Llagas Subbasin Recycled Water Irrigation Sites

Parameter	Number of Wells with Increasing Concentrations	Number of Wells with Stable Concentrations	Number of Wells with Decreasing Concentrations
Bicarbonate	3	16	1
Bromide	1	18	1
Calcium	1	19	0
Chloride	4	15	0
Magnesium	1	19	0
Nitrate	0	20	0
N-Nitrosodimethylamine (NDBA)	0	20	0
N-Nitrosodi-n-Butylamine (NDMA)	0	20	0
Perfluorobutanoic acid (PFBA)	0	19	1
Perfluorooctanoic acid (PFOA)	0	17	3
Perfluorooctane Sulfonate (PFOS)	0	19	1
Potassium	6	14	0
Sodium	5	15	0
Sulfate	1	19	0
Total Dissolved Solids (TDS)	0	17	3

Figure 32. Groundwater Monitoring Near Llagas Subbasin Recycled Water Irrigation Sites



5.6 Salt and Nutrient Management Plans

The SWRCB's 2009 Recycled Water Policy required the development of regional Salt and Nutrient Management Plans (SNMPs) to address current and future regional salt and nutrient loading to groundwater from all sources, including recycled water and agricultural activity. Valley Water completed two SNMPs, one for the Santa Clara Subbasin and one for the Llagas Subbasin by working with local stakeholders and regulators. The plans are posted to Valley Water's website[42] and include salt and nutrient source identification, loading, assimilative capacity estimates, recycled water projections, implementation measures, groundwater monitoring provisions, and an anti-degradation analysis. The San Francisco Bay Regional Water Quality Control Board adopted resolution R2-2016-0046 approving the Santa Clara Subbasin SNMP in November 2016. The Central Coast Regional Water Quality Control Board does not plan to endorse specific SNMPs. Both agencies will use these plans to evaluate future recycled water projects.

[42] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-studies

The SNMPs estimate and project long-term trends in concentrations of salts (using TDS) and nutrients (using nitrate) in groundwater through the year 2035. In general, the main sources for salt loading in the Santa Clara Plain are landscape irrigation and managed recharge, followed by recycled water, whereas agricultural irrigation and managed recharge are the main contributors for the Llagas Subbasin. Table 15 compares the SNMP projections for 2019 with the median values based on groundwater samples in 2019.

Table 15. Comparison of 2019 Median Concentrations with Projected 2019 SNMP Median Concentrations

Groundwater Management Area	2019 SNMP Projected Median	2019 Actual Median	2019 SNMP Projected Median	2019 Actual Median
	TDS, in mg/L		Nitrate as N, in mg/L	
Santa Clara Plain	435	410	2.2	3.1
Coyote Valley	317	384	2.9	4.2
Llagas Subbasin, Shallow Zone	396	384	7.0	6.1
Llagas Subbasin, Principal Zone	376	404	6.4	4.7

Notes:

1. The projected medians are based on the 2019 estimates from the SNMPs. The actual medians are based on 2019 groundwater sample analysis. The Llagas Subbasin SNMP projects the median for both the northern and southern portions of the subbasin. The projected SNMP median shown in this table for each aquifer zone is the average of the north and south subbasin medians.
2. June 2016 SNMP Santa Clara Plain projected median concentrations were not evaluated for shallow and principal aquifer zones separately.

Measured median concentrations of TDS and nitrate are generally in line with SNMP projections with the exception of Coyote Valley. In Coyote Valley, measured TDS levels are higher than what was projected in the SNMP but still below the MCL of 500 mg/L. Discrepancies may be attributed to the SNMP assumptions, which attribute to a steady decrease in estimated concentrations. The SNMP assumes net removal of TDS from Coyote Valley attributed to subbasin outflow, pumping that supplies water to consumers in the Santa Clara Plain, and gaining reaches of streams within Coyote Valley. SNMP assumptions surrounding decreasing TDS concentrations in Coyote Valley will need to be further evaluated.

Both projected and actual measured medians remain below water quality thresholds established in the Regional Water Quality Control Board's Basin Plans for the Santa Clara and Llagas subbasins. As shown in Table 7 and Figures 25 and 26, regional trends for both TDS and nitrate concentrations are generally stable or decreasing in the Santa Clara Plain, Coyote Valley, and the Llagas Subbasin. Valley Water will continue to evaluate measured and projected TDS and nitrate concentrations and their relationship to hydrologic conditions to better understand the causes for fluctuations including the effects on shallow and principal groundwater aquifers.

5.7 Contaminant Release Sites

There are over 350 open cases in Santa Clara County where non-fuel contaminants have been released to soil and/or groundwater. These cases are overseen by the United States Environmental Protection Agency (EPA), California Department of Toxic Substances Control (DTSC), and the Central Coast and San Francisco Bay Regional Water Quality Control Boards (Water Boards). There are also nearly 70 open fuel leak cases overseen by the Santa Clara County Department of Environmental Health (DEH). Of these, approximately 20 are undergoing site assessment, 8 are undergoing site assessment and interim remediation, 10 are undergoing remediation, 22 are

undergoing verification monitoring, and 9 are eligible for closure. In addition, there are over 20 active Superfund sites in Santa Clara County overseen by the EPA. Although there have been very limited impacts to principal drinking water aquifers from these sites, contaminant release sites pose an ongoing threat to groundwater quality.

In 2019, 52 drinking water supply wells had low-level detections of 16 different VOCs.[43] All concentrations of these detected contaminants were below regulatory thresholds, as summarized in Appendix C, Table C-4. The increased number of wells with detected VOCs in 2019 (compared to seven in 2018) is due to a significant increase in the number of water supply wells tested for VOCs, especially PFAS, which may be attributed to increased testing directives or voluntary testing for PFAS. The interconnection between contaminant releases and drinking water supply wells underscores the importance of the ongoing work by the Water Boards, DTSC, EPA, and other regulatory agencies to ensure that contaminant release sites are properly remediated to promote water supply reliability.

Valley Water engages with the primary oversight agencies on certain contaminant release cases based on groundwater vulnerability, proximity to water supply wells or surface water, and contaminant concentration by reviewing monitoring and progress reports, regulatory orders, and correspondence submitted to regulatory agencies. Valley Water is engaged in community meetings for high-threat cases, advocates for expedited cleanup through collaboration with regulatory agencies, provides technical review of other contaminant release sites when requested by regulatory agencies, and shares groundwater data to support their work.

5.8 Well Ordinance Program

Valley Water's well ordinance program helps ensure wells and other deep excavations are properly constructed, maintained, and destroyed to prevent vertical transport of contaminants into deep drinking water aquifers. Nearly 900 permits were issued in 2019 for well construction, well destruction, and exploratory borings. Valley Water inspected over 1,200 wells and borings to ensure they were properly constructed or destroyed (Table 16).

Table 16. CY 2019 Valley Water Well Permit and Inspection Summary

Permit Type	Number Processed
Well Construction - Water Producing Wells	58
Well Construction - Monitoring Wells	313
Well Destruction	277
Exploratory Boring	231
Total	**879**
Inspection Type	**Number Inspected**
Well Construction - Water Producing Wells	56
Well Construction - Monitoring Wells	263
Well Destruction	344
Exploratory Boring	565
Total	**1,228**

[43] None of the wells with VOC detections had all compounds detected; typically, just one or a few related compounds were detected in a single well.

Groundwater Quality Outcome Measures

The evaluation of 2019 groundwater quality data relative to the GWMP outcome measures is summarized below. Additional discussion of outcome measures, including planned action to address measures not being met, is presented in Chapter 6.

OM 2.1.1.e. At least 95% of countywide water supply wells meet primary drinking water standards.
Outcome measure not met. Only 87% of countywide water supply wells tested in 2019 met all primary drinking water standards; 100% of countywide water supply wells met all primary drinking water standards when excluding nitrate exceedances. Most MCL exceedances were due to elevated nitrate levels in South County, primarily in domestic wells.

OM 2.1.1.f. At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives.
Outcome measure met. This measure is met with 100% of all Coyote Valley and Llagas Subbasin wells meeting Basin Plan agricultural objectives in 2019.

OM 2.1.1.g. At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.

Outcome measure partially met. This measure is not met for chloride, with only 82% of wells having stable or decreasing concentrations. The measure is met for nitrate and total dissolved solids, with stable or decreasing concentrations observed in 91% and 94% of wells, respectively.

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CHAPTER 6 – GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION

This chapter summarizes the status of Valley Water's Groundwater Management Plan (Plan) implementation, including outcome measure performance, recommendations, and SGMA compliance.

6.1 Outcome Measure Performance and Action Plan

The Plan identifies outcome measures to assess performance relative to Board policy and groundwater sustainability goals. The status using 2019 data is shown below, with related actions to address measures not being met.

Table 17. Summary of Outcome Measure Performance

Groundwater Storage	**OM 2.1.1.a.** Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain. **Outcome measure met:** End of 2019 groundwater storage is 315,700 AF.
	OM 2.1.1.b. Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley. **Outcome measure met:** End of 2019 groundwater storage is 12,800 AF.
	OM 2.1.1.c. Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin. **Outcome measure met:** End of 2019 groundwater storage is 28,200 AF.
Groundwater Levels and Subsidence	**OM 2.1.1.d.** 100% of subsidence index wells with groundwater levels above subsidence thresholds. **Outcome measure met:** All ten wells had groundwater levels above thresholds in 2019.
Groundwater Quality	**OM 2.1.1.e.** At least 95% of countywide water supply wells meet primary drinking water standards. **Outcome measure not met:** Only 87% of wells tested in 2019 had water that met primary drinking water standards due to elevated nitrate, mainly in South County domestic wells. If nitrate is not included, 100% of water supply wells met primary drinking water standards. **OM 2.1.1.f.** At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives. **Outcome measure met:** All wells (100%) had water quality that met agricultural objectives.
	Action Plan for OM 2.1.1.e: Implement Salt and Nutrient Management Plans to address nitrate, continue free domestic well testing and nitrate treatment system rebate programs, and continue collaborating with regulatory and land use agencies to address nitrate loading.
Groundwater Quality Trends	**OM 2.1.1.g.** At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids. **Outcome measure partially met:** This measure is not met for chloride, with 82% of wells having water with stable or decreasing concentration trends. The measure is met for nitrate and total dissolved solids, with stable or decreasing concentrations observed in 91% and 94% of wells, respectively.
	Action Plan for OM 2.1.1.g: Implement Salt and Nutrient Management Plans to address salt loading, continue collaborating with regulatory and land use agencies.

As shown in Table 17, all outcome measures related to groundwater storage, levels, and land subsidence were met in 2019 due to healthy groundwater conditions that are fully recovered from the 2012-2016 drought. The rapid recovery to pre-drought conditions demonstrates the effectiveness of significant investments in diverse water supplies and conjunctive water management, as well as close coordination with water retailers.

While most wells have stable or decreasing long-term chloride, nitrate, and total dissolved solids concentration trends, some upward trends were observed and warrant further evaluation. Valley Water will assess the potential cause, continue to implement the Salt and Nutrient Management Plans, and engage with regulatory and/or land use agencies as needed.

Elevated nitrate continues to be the primary groundwater protection challenge, particularly in South County. This condition is not unique to Santa Clara County as nitrate contamination is an issue in many agricultural or rural areas throughout the state. Long-term nitrate trends in Santa Clara County indicate stable or improving conditions, which is certainly preferable to worsening conditions. However, a significant number of South County wells (primarily domestic wells) still contain nitrate above the drinking water standard. Valley Water does not control land use or have regulatory authority over activities with the most nitrate loading to groundwater, such as irrigated agriculture or septic systems. However, Valley Water continues to coordinate with land use and regulatory agencies to influence policies, regulations, and decisions related to nitrate management. More directly, Valley Water's managed recharge programs help dilute nitrate in groundwater, and water quality testing and treatment system rebates help to reduce well owner exposure.

6.2 Status of Groundwater Management Plan Recommendations

As described in the Plan and demonstrated in this report, Valley Water's proactive groundwater management programs and activities have maintained sustainable groundwater levels and storage, minimized land subsidence, and improved groundwater protection. The Plan presents six major recommendations to maintain the long-term viability of groundwater resources. A summary of the status of each recommendation is below.

1. **Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.**

   This Plan recommendation has several sub-recommendations, including items related to infrastructure reliability, high-priority capital project implementation, and securing imported water sources, among others. Valley Water continues to focus on extensive groundwater recharge through direct replenishment and in-lieu recharge. Updates relative to this Plan recommendation are presented below.

   Capital Projects Supporting Conjunctive Management

   Valley Water's Fiscal Year Draft 2021-25 Five-Year Capital Improvement Program (CIP) was approved for release on February 25, 2020.[44] With a significant portion of Valley Water's water supply infrastructure approaching fifty to sixty years of age, maintaining and upgrading the existing infrastructure to ensure each facility functions as intended for its useful life became the focus of the Water Supply CIP in recent years. Other CIP projects focus on expanding in-lieu and direct recharge through recycled and purified water projects. Major water supply capital improvements identified in the CIP include:

   Storage:
   - Almaden Dam Improvements
   - Anderson Dam Seismic Retrofit
   - Calero Dam Seismic Retrofit

[44] The 2021-25 CIP is available at: https://www.valleywater.org/how-we-operate/five-year-capital-improvement-program

- Guadalupe Dam Seismic Retrofit
- Pacheco Reservoir Expansion

Transmission:
- 10-Year Pipeline Rehabilitation
- Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Implementation
- Main and Madrone Pipeline Rehabilitation
- Vasona Pumping Plant Upgrade
- Almaden Valley Pipeline Replacement

Treatment:
- Penitencia Water Treatment Plant Residuals Management
- Rinconada Water Treatment Plant Reliability Improvement
- Santa Teresa Water Treatment Plant Filter Media Replacement
- Water Treatment Plant Electrical Improvement

Recycled Water:
- Expedited Purified Water Program
- South County Recycled Water Pipeline

Detailed information on each of these water supply capital projects, including related description, costs, and schedule, is available in the CIP.

2. **Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.**

A reliable water supply depends not only on quantity, but on quality. Sub-recommendations from the Plan include continued groundwater quality monitoring, action when potentially adverse trends are identified, and continued and enhanced collaboration with local partners and stakeholders.

Groundwater quality is typically very good in the county, with no treatment beyond disinfection required at major retailer wells. However, nitrate remains an ongoing groundwater protection challenge, particularly in the more rural Coyote Valley and Llagas Subbasin. Valley Water continues to conduct extensive groundwater quality monitoring, evaluate long-term trends, and compare current conditions against regulatory standards and projected concentrations (such as from Salt and Nutrient Management Plans).

Long-term trends are favorable for nitrate, with 91% of wells tested showing stable or decreasing concentrations. However, since a significant number of domestic wells in the Llagas Subbasin still contain nitrate above the drinking water standard, more work remains to be done. Valley Water offers rebates of up to $500 for nitrate treatment systems and will continue to engage with regulatory and land use agencies to address existing nitrate contamination. For nitrate and other water quality issues, Valley Water will work to build and enhance this collaboration to protect high-quality groundwater and expedite the restoration of impacted groundwater.

Valley Water is working with land use agencies on a Stormwater Resources Plan to increase infiltration while ensuring pollutants from urban runoff are not merely transmitted from surface water to groundwater. Similarly, Valley Water continues to engage with various entities to ensure that recycled water expansion or the use of purified water for recharge will be protective of groundwater quality.

Engaging with land use and regulatory agencies on proposed policy, legislation, and projects that may impact groundwater remains a key strategy for protecting groundwater. For example, Valley Water tracks the progress

of major contaminant release sites, interacting with regulatory agencies to promote expedited and thorough cleanup. Valley Water also engages with land use agencies on relevant projects and policies such as development, stormwater infiltration devices, septic systems, and small water systems.

Public outreach continues to be an important component of Valley Water's groundwater protection efforts. Valley Water annually celebrates Groundwater Awareness Week by highlighting groundwater on the Valley Water website and posting related social media messages. Valley Water also maintained its status as a Groundwater Guardian through a program sponsored by the non-profit Groundwater Foundation. This is an annually earned designation for communities and affiliates that take voluntary, proactive steps toward groundwater protection.

To provide information on well sampling by Valley Water and local water suppliers, Valley Water prepared the 2019 Groundwater Quality Summary. This is similar to water retailer consumer confidence reports and provides basic groundwater quality information to domestic well owners who do not typically receive water from a water retailer.

Other groundwater-related public outreach conducted by Valley Water in 2019 included:

- Interaction with thousands of students through the Education Outreach program.
- Direct communication with well owners on groundwater quality, well maintenance, and treatment systems under the Domestic Well Testing and Nitrate Treatment System Rebate programs.

3. Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.

This Plan recommendation focuses on continued, thoughtful water supply planning and investments. In November 2019, Valley Water completed an update to the Water Supply Master Plan 2040[45], which explains Valley Water's strategy for providing a reliable and sustainable water supply into the future. The Water Supply Master Plan 2040 informs investment decisions and provides a framework for annually monitoring the water supply strategy to ensure it will meet the water needs of Santa Clara County. Staff held multiple workshops with water retailers and stakeholders and presented information to the Board and the Board's Water Conservation and Demand Management Committee on numerous occasions. These presentations have included information on the proposed level of service goal and potential water supply investment strategies. The Valley Water investment strategy includes securing existing supplies, expanding water conservation and reuse, and optimizing the system. Projects approved by the Board for planning include advanced metering infrastructure, leak repair incentives, expansion of Valley Water's graywater program, a model water-efficient ordinance for new developments, decentralized stormwater capture (e.g., incentives for rain barrels, cisterns, and rain gardens), and centralized stormwater capture (e.g., flooding of agricultural lands), 24 thousand acre-feet of potable reuse, the Delta Conveyance Project, expanding Pacheco Reservoir, and the Transfer-Bethany Pipeline. Details about each of these projects can be found in Appendix H of the Water Supply Master Plan 2040.

Groundwater sustainability also remains an important factor during the planning and implementation of multi-benefit projects under Valley Water's One Water Plan.[46] The Sustainable Groundwater and Water Quality objectives of the One Water Plan align with the Plan outcome measures and the process to identify individual projects on the watershed scale (e.g., Coyote Watershed) accounts for groundwater conditions and sustainability.

To support managed response to climate change, Valley Water is developing a Climate Change Action Plan (CCAP) that will be completed in 2020. The CCAP will include comprehensive review of climate change as it

[45] Santa Clara Valley Water District, Water Supply Master Plan 2040 is available at: https://www.valleywater.org/sites/default/files/Water%20Supply%20Master%20Plan%202040_11.01.2019_v2.pdf
[46] https://onewaterplan.wordpress.com/

relates to Valley Water core services and include goals, strategies, and possible actions to respond to climate change. The CCAP will identify potential future climate change vulnerabilities and risks to all core service areas, including water supply and groundwater management. The CCAP will provide goals and strategies to reduce risks to Valley Water core services and its mission. The strategies will be incorporated into existing Valley Water plans, budgets, and long-term financial forecasts as appropriate.

4. **Maintain adequate monitoring programs and modeling tools.**

   This Plan recommendation focuses on improving monitoring networks by identifying and addressing gaps, redundancies, and access issues; identifying and implementing improvements to the numerical groundwater flow models; and improving Valley Water's understanding of surface water/groundwater interaction and groundwater dependent ecosystems (GDEs).

   Valley Water continues to offer free basic well testing for domestic well owners to supplement regional groundwater quality monitoring, which emphasizes the use of consistent wells. Through this voluntary program, Valley Water obtains valuable data on nitrate and other contaminants while providing important water quality data to about 200 private well owners each year. Valley Water is evaluating the recycled water and recharge water quality monitoring networks to ensure they meet monitoring objectives in terms of frequency, locations, and constituents analyzed. Monthly Water Tracker[47] and groundwater condition reports[48] help keep stakeholders informed about current groundwater conditions including groundwater pumping, recharge, and water levels.

   Valley Water uses three calibrated groundwater flow models – one for each groundwater management area (Santa Clara Plain, Coyote Valley, and the Llagas Subbasin). These models are used to evaluate groundwater storage and levels to inform operational decisions and long-term planning efforts. Staff is assessing each model to identify related improvements or enhancements that may be needed or desired to improve the use of these tools.

   Regarding surface water/groundwater interaction, Valley Water staff has begun to evaluate available data for stream gauging and groundwater levels, and whether existing wells adjacent to creeks may be useful in collecting additional data. Staff has attended workshops organized by DWR and reviewed both relevant literature and how other Groundwater Sustainability Agencies (GSAs) are working to better understand groundwater-surface water interaction. Staff has also performed preliminary experiments to measure the flux between surface water and groundwater. Valley Water will continue to explore the complex and dynamic interaction between surface water and groundwater and will engage interested stakeholders. This issue will be further documented in the five-year Groundwater Management Plan update, which is due by January 1, 2022.

5. **Continue and enhance groundwater management partnerships with water retailers and land use agencies.**

   This Plan recommendation focuses on continued collaboration and strong partnerships with water retailers and land use agencies. Valley Water continues to interact regularly with water retailers through quarterly Water Retailer meetings, including the Groundwater Subcommittee. In addition to these regular meetings, Valley Water and water retailers collaborate on various issues that arise regarding groundwater, treated water, wells, and water measurement.

   Valley Water also continues to coordinate with local land use agencies on General Plans, water supply assessments, Urban Water Management Plans, stormwater management, and various individual land use projects. Land use decisions fall under the authority of the local cities and the County of Santa Clara. Valley

[47] https://www.valleywater.org/your-water/water-supply-planning/monthly-water-tracker
[48] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-monitoring

Water reviews land use and development plans related to Valley Water facilities and watercourses under Valley Water jurisdiction and provides technical review for other land use proposals as requested by the local agency. When provided by land use agencies, water supply assessments for new developments are also reviewed and evaluated in the context of Valley Water's long-term water supply plans. For all reviews, Valley Water's groundwater-related comments focus on potential impacts to groundwater quality and sustainability.

6. **Evaluate the potential new authorities provided by SGMA.**

The Santa Clara Valley Water District Act provides broad authorities, but there are additional authorities under SGMA including the ability to regulate pumping or impose various types of fees. This Plan recommendation focused on the evaluation of these new SGMA authorities in cooperation with water retailers and other interested stakeholders to consider what conditions might necessitate their implementation to sustainably manage groundwater into the future.

As first described in the WY 2017 Annual SGMA Report submitted to DWR, Valley Water has explored new SGMA authorities with interested stakeholders through the Board's Water Conservation and Demand Management Committee (Committee). Nine publicly noticed Committee meetings between December 2016 and December 2017 provided a transparent forum for discussion with interested stakeholders on how and when these authorities might be used.

The potential regulation of pumping or well construction is a complex and controversial topic, which was discussed extensively through Committee meetings. Existing groundwater management programs and strong partnerships with large pumpers are expected to result in continued sustainable conditions and are the preferred way to address future challenges. However, pumping regulation may be needed in the future to address undesirable results. The primary SGMA-related work product from the Committee meetings was a process that describes the fundamental approach to respond to potential worsening basin conditions. This includes the steps that would be taken prior to implementing SGMA authorities to regulate groundwater pumping, with a focus on providing some certainty on the process, while avoiding prescriptive requirements that may not be effective in addressing a future issue. This process was memorialized via a resolution adopted by Valley Water Board on February 27, 2018. This resolution was included as Attachment 2 in the WY 2018 Annual SGMA report to DWR.

Valley Water also explored the potential to implement a fixed charge as a component of groundwater production charges, which are currently volumetric charges. This could potentially reduce volatility in rates and revenues based on changes in water use. Valley Water engaged a consultant to develop a fixed charge proposal and assist with implementation. However, major water retailers expressed significant concerns, including redundancy with other charges or charge adjustment mechanisms, equity in applying the charge to all well users, and potential cost recovery impacts to retailers regulated by the California Public Utilities Commission. After discussing these concerns with the Committee and the full Board, Valley Water is unlikely to further pursue a fixed charge at this time.

6.3 Status of Sustainable Groundwater Management Act Compliance

In December 2016, Valley Water submitted the Plan (for the Santa Clara and Llagas Subbasins) to DWR as an Alternative to a Groundwater Sustainability Plan (GSP). In July 2019, DWR issued an assessment, finding the Valley Water Plan satisfies the objectives of SGMA and is an acceptable Alternative. Valley Water will be required to submit an updated Plan every five years, with the next Plan due by January 1, 2022.

Once an Alternative or GSP is submitted, SGMA requires that specific information on groundwater use, levels, and storage be reported annually by April 1 for the previous water year. In April 2020, Valley Water submitted the third annual report required by SGMA (Appendix F). Because most Valley Water planning efforts are based on the

calendar year, this Annual Groundwater Report presents some of the same information based on the calendar year. It also provides more detailed information on groundwater conditions, particularly regarding groundwater quality.

Valley Water is also the GSA for the small portions of the North San Benito Subbasin within Santa Clara County.[49] As such, staff is supporting efforts led by the San Benito County Water District[50] to develop a GSP by the statutory deadline of January 2022. This includes serving on the Technical Advisory Committee, sharing relevant data, and other coordination as needed.

Continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion," in accordance with Board policy. Valley Water's approach to groundwater management has evolved over many decades to address numerous challenges, and this adaptive approach will help ensure continued sustainability.

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[49] A basin boundary modification was approved by DWR in 2019 to consolidate four subbasins primarily located in San Benito County. These include the Hollister and San Juan Bautista Area subbasins, which extend into Santa Clara County.
[50] The GSA for the portions of the North San Benito Subbasin located in San Benito County.

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APPENDIX A
2019 Subsidence Data Analysis

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TECHNICAL MEMORANDUM

2019 SUBSIDENCE DATA ANALYSIS

Prepared by:

Yaping Liu, Ph.D., P.E.
Associate Civil Engineer

Under the Direction of:

Vanessa De La Piedra, P.E.
Unit Manager

Santa Clara Valley Water District
Groundwater Management Unit

March 2020

EXECUTIVE SUMMARY

This technical memo presents land subsidence data analysis for calendar year 2019. Throughout the first two thirds of the 20th Century, land subsidence occurred in the Santa Clara Plain in northern Santa Clara County mainly due to groundwater overdraft causing declining groundwater elevations and pressures. Permanent (inelastic) subsidence was essentially halted in the early 1970s through Valley Water's conjunctive management programs and investments (Valley Water, 2019). Monitoring continues and is critical to fulfilling Valley Water's mission of minimizing land subsidence and saltwater intrusion (Board Ends Policy 2.1.1). Monitoring provides data to evaluate current conditions and for early detection of the potential resumption of permanent subsidence. Annually, Valley Water analyzes land subsidence monitoring data, evaluates subsidence conditions, and recommends improvements to the subsidence monitoring network. Data collected mainly from 2009 to 2019 is used in this analysis.

2019 annual precipitation was 16.11 inches (NOAA San Jose Station: GHCND:USW00023293), in comparison to the average annual precipitation of 14.50 inches in the Santa Clara Plain. The annual estimated groundwater pumping in 2019 was 57,700 acre-feet (AF). 2019 total estimated groundwater recharge was 71,400 AF, of which 42,000 AF was managed recharge and 29,400 AF was natural recharge. Since total recharge exceeded pumping, the overall groundwater storage increased in the Santa Clara Plain in 2019.

The data measured in 2019 through the Valley Water's subsidence monitoring network show the following:

- 2019 annual average of groundwater elevations were near historically high levels. The groundwater elevations were above subsidence thresholds at all ten index wells for the entire year.
- Aquifer expansion (uplift) was measured at the Valley Water's two extensometer sites in 2019. The average annual subsidence rate over the last 11 years (2009-2019) at the San Jose (Martha) and Sunnyvale (Sunny) sites is -0.006 feet/year (aquifer expansion), which meets the Valley Water's established tolerable subsidence rate of not more than 0.01 feet/year.
- Between 2018 and 2019, the average land surface elevation change was close to zero at all survey benchmarks, indicating little land elevation change in 2019. Over the last 11 years (2009-2019), the average annual change in land surface elevations was slightly greater than zero (uplift) at all survey benchmarks.

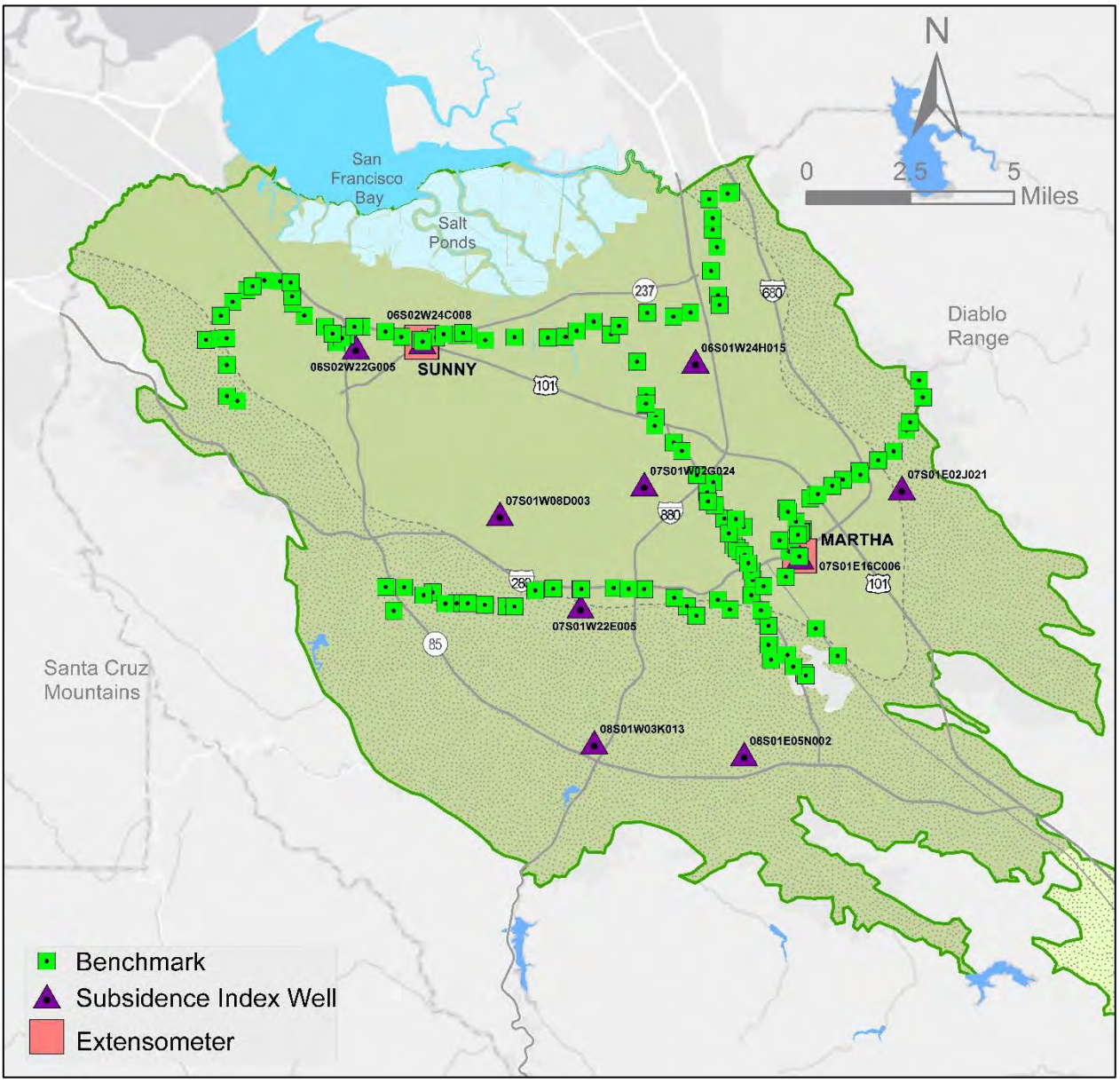
The analysis of the data collected through Valley Water's subsidence monitoring network indicates that the risk of land subsidence in 2019 was very low and similar to or less than 2018. Monitoring of the subsidence network will continue as it is needed to detect early signs of permanent land subsidence and to ensure a sustainable groundwater supply.

BACKGROUND

The Santa Clara Plain is a groundwater management area occupying the northwestern and largest part of the Santa Clara Subbasin. The Santa Clara Plain extends from Santa Clara County's northern boundary to approximately Metcalf Road in the Coyote Valley and is bounded on the west by the Santa Cruz Mountains and the east by the Diablo Range (Figure 1). Land subsidence has caused serious problems in the Santa Clara Plain prior to about the 1970s, including nearly 13 feet of permanent subsidence in

downtown San Jose and more than a foot of permanent subsidence over the surrounding hundred square miles.

Figure 1. Valley Water subsidence monitoring network.



Ongoing monitoring provides data for current land subsidence evaluation and early detection of potential permanent subsidence. The Valley Water land subsidence monitoring network (Figure 1) includes:

- Two extensometers: one in Sunnyvale (Sunny) and one in San Jose (Martha), both are monitored continuously by telemetry systems;
- Approximately 140 elevation benchmarks along three Cross Valley Level Circuits (CVLCs) are surveyed in the fall of every year; and

- Ten subsidence index wells with groundwater elevations monitored at least monthly, including two subsidence index wells that are located at the Sunny and Martha extensometer sites.

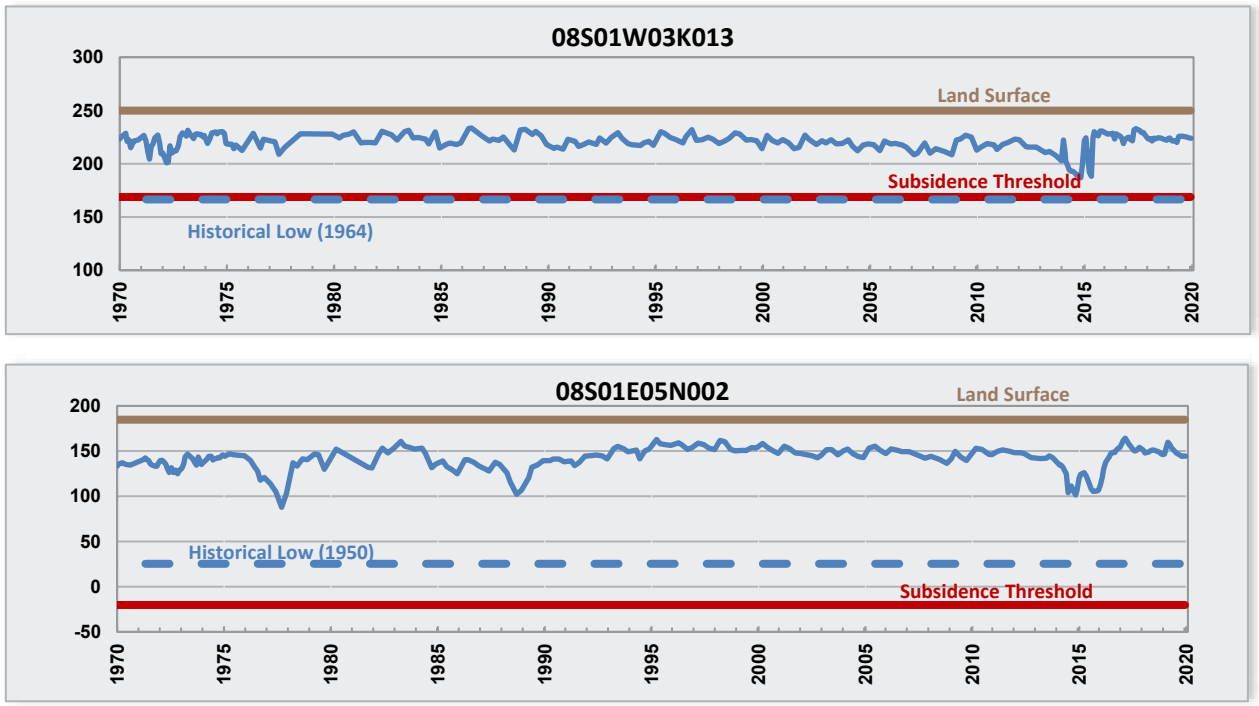
EVALUATION

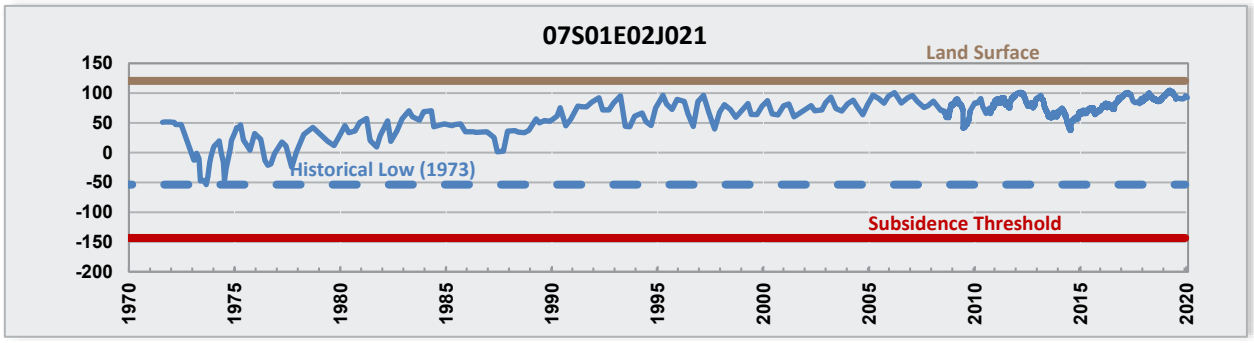
Figure 1 shows a map of the Valley Water subsidence monitoring network in the Santa Clara Plain. Two extensometers are in the confined area of the Santa Clara Plain. Benchmarks are grouped into three CVLCs: Guadalupe (northwest-trending circuit along the axis of the valley), Los Altos (west-east trending circuit to the north), and Alum Rock circuit (west-east trending circuit to the south). The ten subsidence index wells are located throughout the Santa Clara Plain.

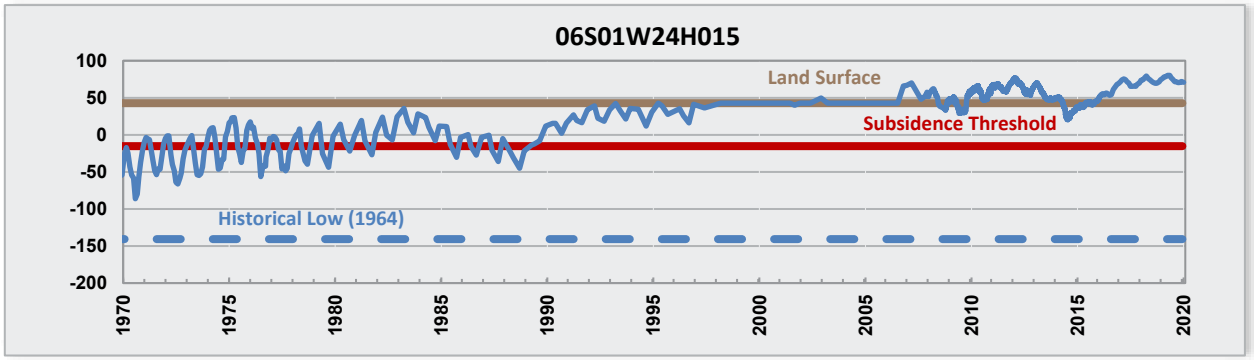
Groundwater elevation analysis

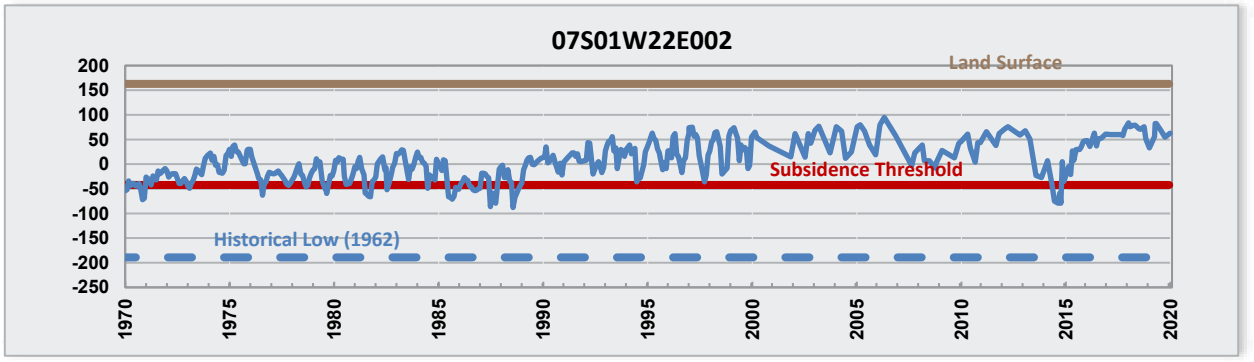
Groundwater elevation monitoring is an integral part of the land subsidence monitoring program since the decrease in water elevation is the driving force of land subsidence in the Santa Clara Plain. The current frequency of groundwater elevation monitoring at subsidence index wells varies from daily to monthly. Water elevation hydrographs at the ten index wells are presented in Figure 2, along with land surface elevations, historical low water levels, and subsidence groundwater elevation thresholds determined for each well (GEOSCIENCE, 1991). The North American Vertical Datum of 1988 (NAVD88) is used for the groundwater elevation values in this document.

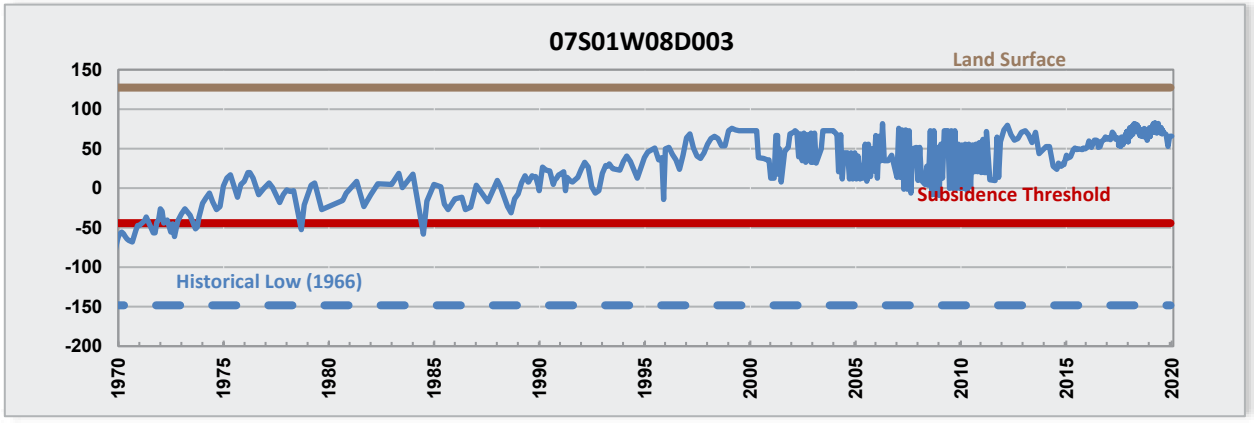
Figure 2. Measured groundwater elevation at subsidence index wells (Feet, NAVD88)




07S01E02J021
Land Surface
Historical Low (1973)
Subsidence Threshold
150
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


06S01W24H015
Land Surface
Subsidence Threshold
Historical Low (1964)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


07S01W22E002
Land Surface
Subsidence Threshold
Historical Low (1962)
200
150
100
50
0
-50
-100
-150
-200
-250
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


07S01W08D003
Land Surface
Subsidence Threshold
Historical Low (1966)
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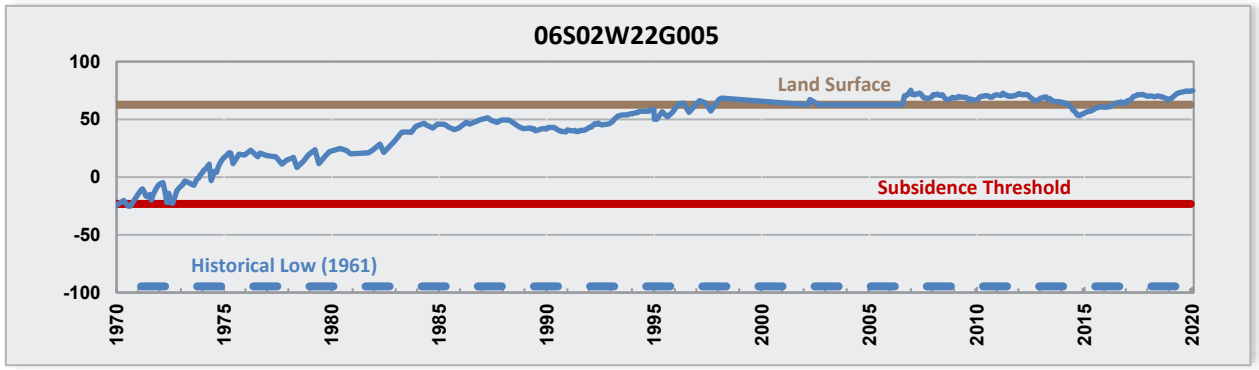
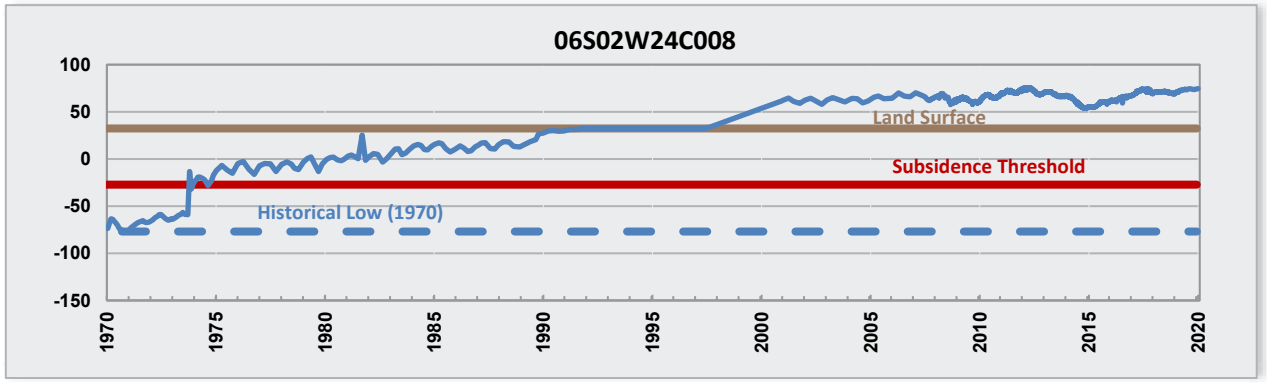
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


06S02W22G005
Land Surface
Subsidence Threshold
Historical Low (1961)
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


06S02W24C008
Land Surface
Subsidence Threshold
Historical Low (1970)
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50
0
-50
-100
-150
1970
1975
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1985
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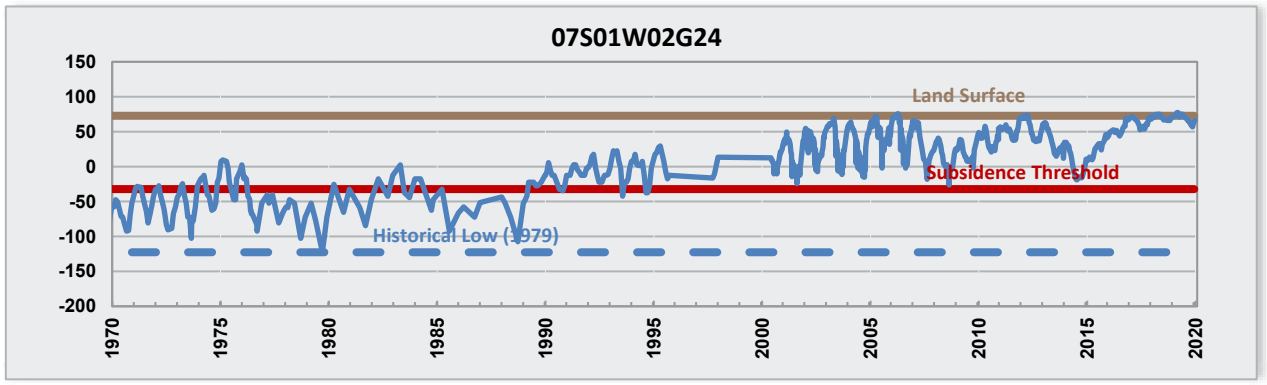
1995
2000
2005
2010
2015
2020


07S01W02G24
Land Surface
Subsidence Threshold
Historical Low (1979)
150
100
50
0
-50
-100
-150
-200
1970
1975
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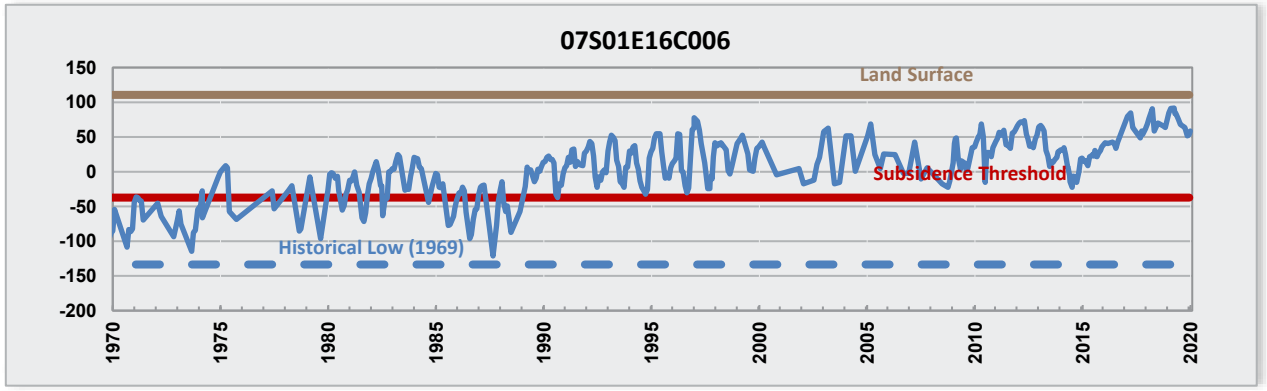

07S01E16C006
Land Surface
Subsidence Threshold
Historical Low (1969)
150
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

A subsidence threshold is a recommended groundwater elevation; maintaining groundwater at elevations near or below the threshold for extended periods of time increases the risk of subsidence resumption and potential damage to facilities and infrastructures. Historically, land subsidence was observed mainly in the confined area of the Santa Clara Plain. Accordingly, most index wells (eight out of ten) are in or near the confined area. Valley Water's groundwater management goal is to maintain groundwater elevations in the Santa Clara Plain above subsidence thresholds to minimize the risk of resuming permanent land subsidence.

Historical low groundwater elevations at most wells in Santa Clara Plain were observed in the 1960s and 1970s. Since then, the groundwater elevations have been generally in recovery due to the importation of surface water from the Delta and related increased managed recharge and/or reduced groundwater pumping. Due to drought conditions, groundwater elevations in the Santa Clara Plain had been generally declining starting in 2012 and reached recent low water elevations in 2014. During this period, groundwater elevations at three subsidence index wells (well numbers 07S01W22E002, 07S01E16C006, and 07S01W02G024) were close to or below subsidence thresholds and thus increased the risk of land subsidence.

The annual precipitation from 2016 to 2019 was close to or above the normal after a four-year drought (from 2012 to 2015). The average groundwater elevations rose in 2016 and 2017 and remained high in 2018 and 2019 at all subsidence index wells (Figure 2). Groundwater elevations at the end of 2019 were well above subsidence thresholds. The main drivers of the water elevation recovery from 2016 to 2019 were the reduced pumping and increased recharge. The total recharge amount, including the managed recharge and natural recharge, was about 1.5 times the pumping on a four-year average for 2016 to 2019. This resulted in the water elevations at end of 2019 being 19 to 144 feet higher than the lowest water elevations in 2014 in subsidence index wells.

It is critical to manage the groundwater basin in a manner that maintains a groundwater gradient towards the San Francisco Bay to keep saltwater from entering the groundwater aquifer. There are three index wells along the bay front: 06S02W22G005, 06S02W24C008 and 06S01W24H015. Beginning in 2012, groundwater elevations in those three wells declined consistently, reaching their recent low elevations in 2014. As described above, a substantial water elevation recovery was observed since 2014. By the end of 2019, all three bay front index wells were flowing artesian, which reduces the risk of saltwater intrusion.

In summary, groundwater elevations measured at subsidence index wells were maintained well above subsidence thresholds throughout 2019. Measured groundwater elevations indicate that the risk of both land subsidence resumption and saltwater intrusion was minimal in 2019 and was substantially reduced as compared to 2014.

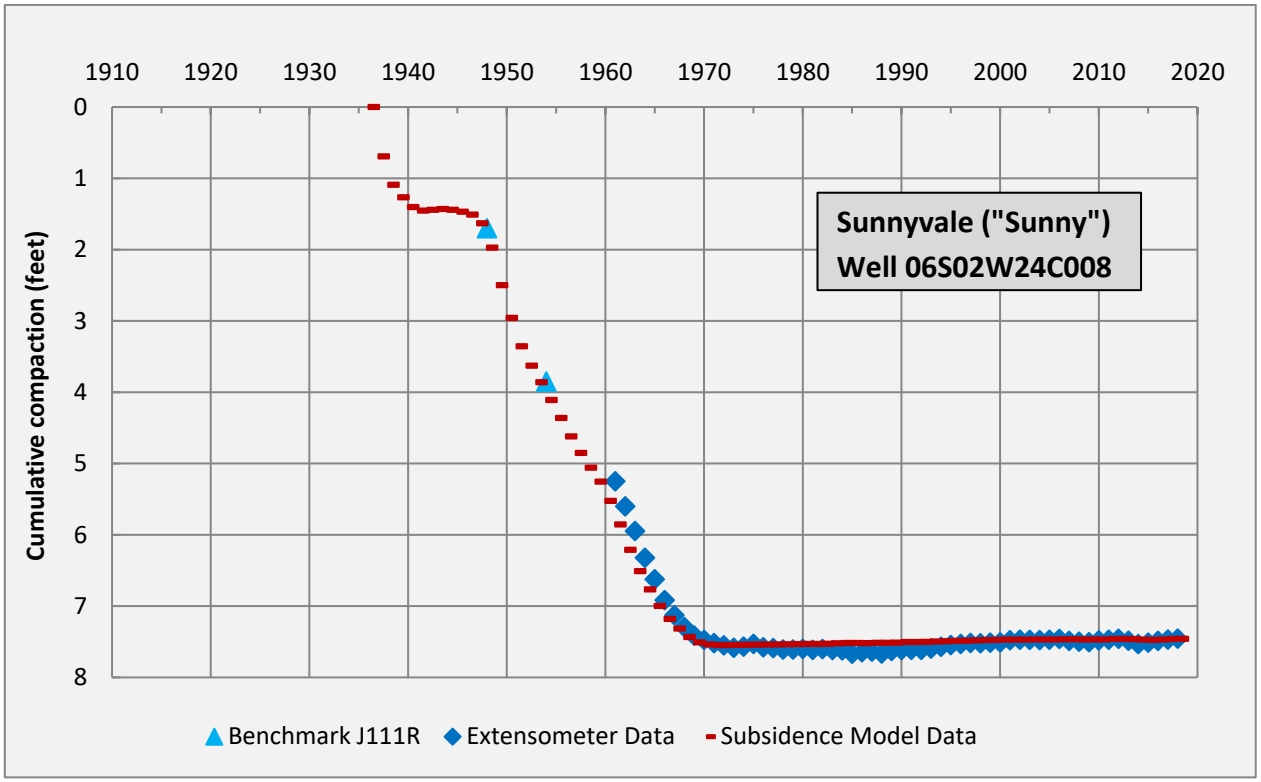
Extensometer data analysis

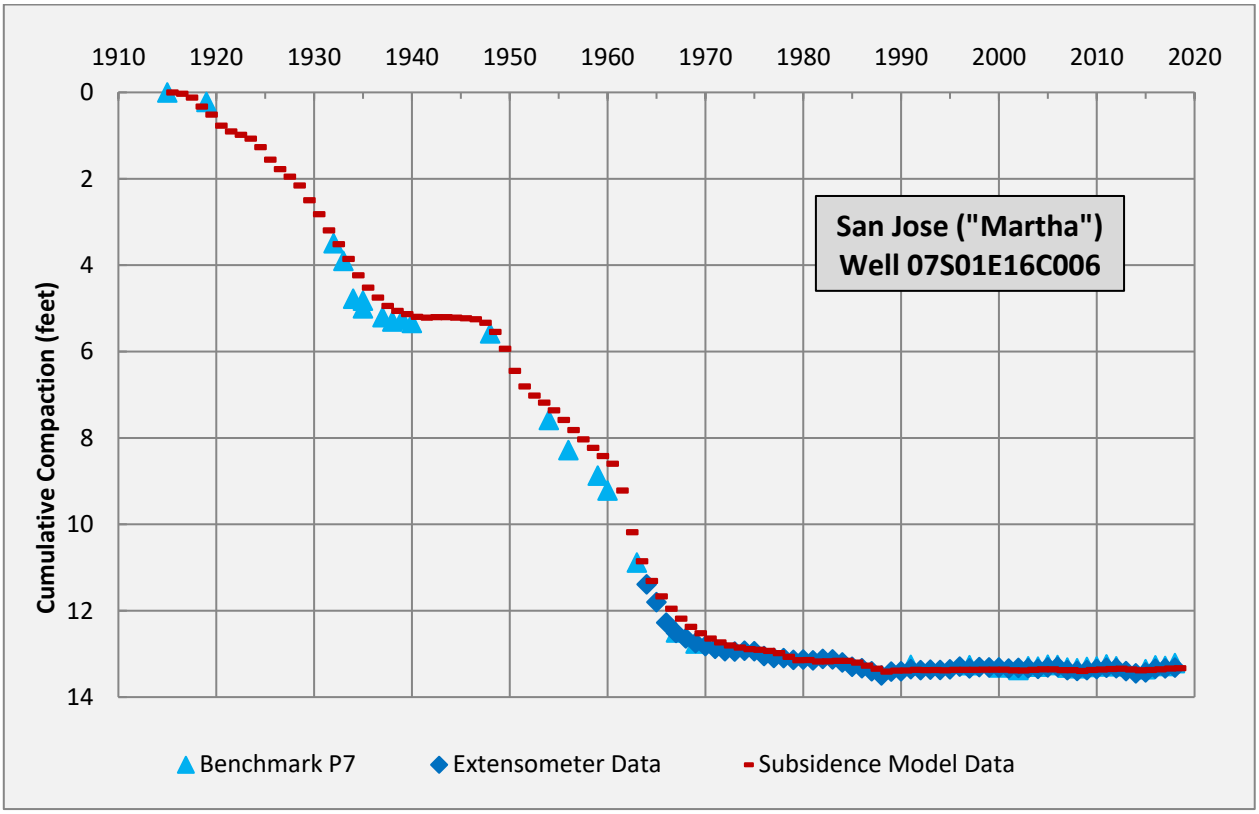
Daily aquifer compaction/expansion data measured at two extensometers and depth to water (DTW) measured at or near the extensometers were used for this analysis. An extensometer is a device used to continuously monitor aquifer compaction (subsidence) and expansion (uplift). The extensometers were installed in the early 1960s in Sunnyvale (Sunny) and San Jose (Martha) to measure the compaction or expansion of the first 1,000 feet of the aquifer system. The extensometer sites were selected in areas with high land subsidence between the 1930s and 1960s. These areas were also pumping centers during

that period. Valley Water's goal for the average value of subsidence measured at these two sites over the last 11 years is not to exceed a tolerable subsidence rate of 0.01 feet/year (GEOSCIENCE, 1991).

Long- term data: Figure 3 shows cumulative compaction measured at the extensometers for the period of record supplemented with nearby benchmark data. Land subsidence occurred mostly prior to 1970 and has been negligible over the last several decades (Figure 3). There is close correlation between Valley Water's land subsidence model (PRESS model) output and observed compaction.

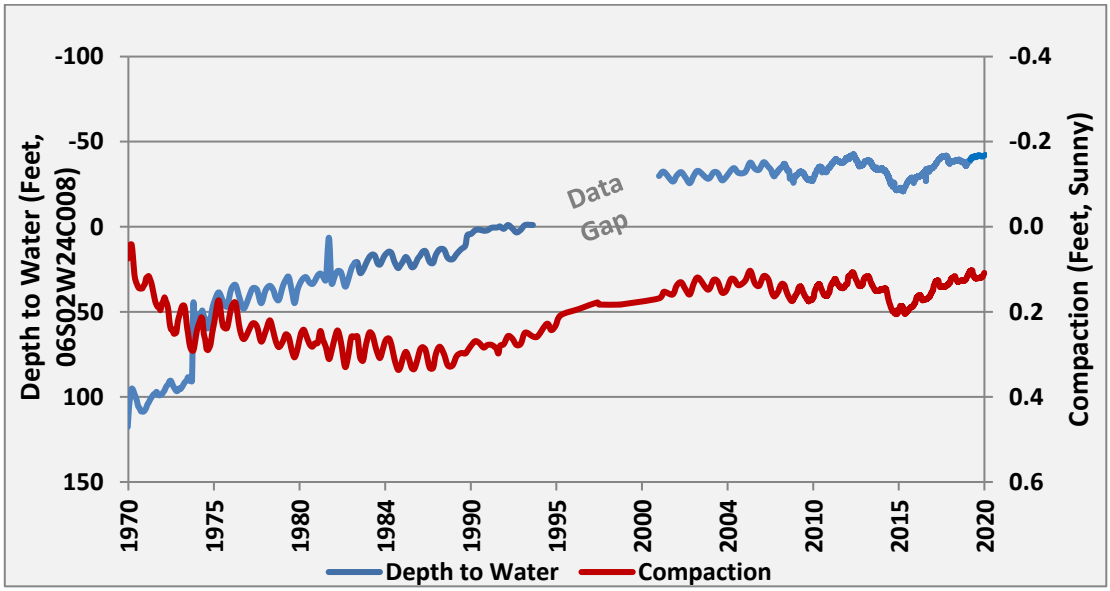
Figure 3. Cumulative compaction at extensometers.

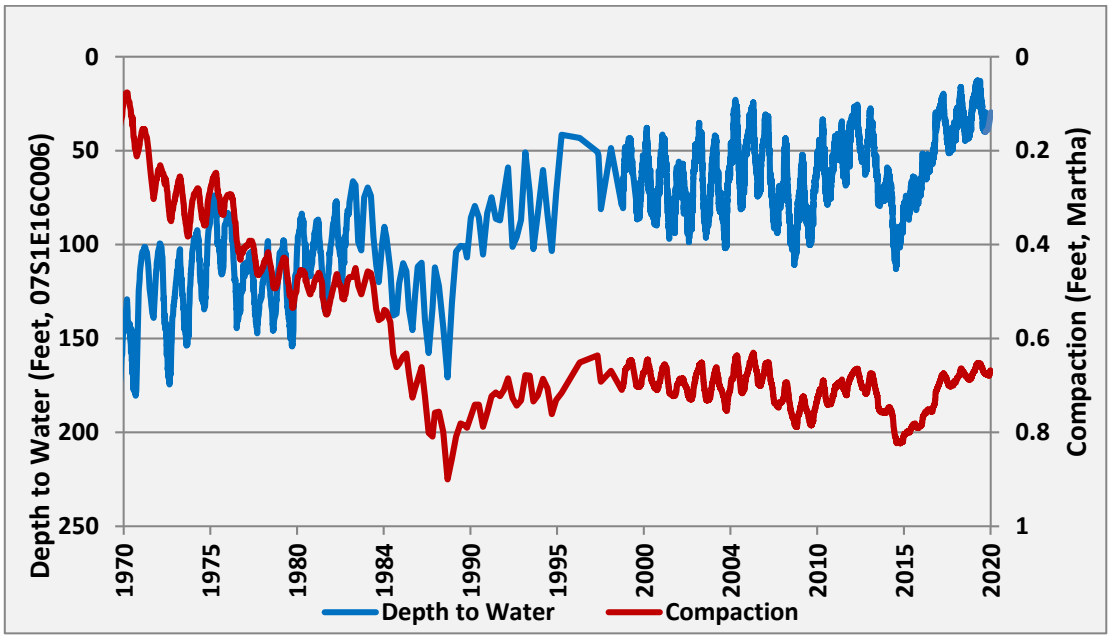




Permanent (inelastic) subsidence was essentially halted in the early 1970s. Figure 4 presents the cumulative aquifer compaction/expansion and DTW from 1970 to 2019 for the Sunny and Martha extensometers, respectively. There are some differences in compaction/expansion and DTW at the two sites during this period: (1) the aquifer compaction since 1970 has been recovered about 83% at Sunny site and only 28% recovered at Martha by the end of 2019; (2) the groundwater elevation at Sunny has been above the land surface (negative DTW) since 1993, while the groundwater elevation at Martha has consistently been below the land surface (positive DTW); and (3) the seasonal water elevation change at Sunny is relatively small when compared to that at Martha. Those differences indicate that the pumping activity and scale at Sunny site is less than that at Martha site. Less pumping and the presence of artesian pressure helped the recovery of compacted aquifer at Sunny site, while continued pumping activity and relatively lower water level resulted in less recovery of compacted aquifer at Martha site from 1970 to 2019.

Figure 4. Measured depth to water and cumulative compaction at extensometers.





Current conditions: Measured extensometer data is used to evaluate current land subsidence conditions. Table 1 shows measured annual subsidence from 2009 to 2019 and the calculated 11-year average at Sunny and Martha. The 11-year average of annual subsidence rate is -0.006 feet/year, with the negative value of extensometer data indicating aquifer expansion (or uplift). This value meets the Valley Water tolerable subsidence rate goal of not exceeding 0.01 feet/year. Comparing to the value reported in the 2018 Subsidence Data Analysis Technical Memorandum, the 11-year average value changed from -0.004 feet/year in 2018 to -0.006 feet/year in 2019, net average uplift of 0.002 feet/year.

Table 1. Measured annual land subsidence at the Sunnyvale (Sunny) and San Jose (Martha) extensometers from 2009 to 2019

Year	Sunny (feet/year)	Martha (feet/year)	Average at Two Sites (feet/year)
2009	0.008	-0.020	-0.006
2010	-0.025	-0.024	-0.025
2011	-0.009	-0.032	-0.021
2012	-0.014	0.013	-0.001
2013	0.026	0.064	0.045
2014	0.049	0.053	0.051
2015	-0.022	-0.021	-0.022
2016	-0.025	-0.087	-0.056
2017	-0.018	-0.007	-0.013
2018	-0.013	-0.020	-0.017
2019	-0.009	-0.005	-0.007
Average from 2009 – 2019	-0.004	-0.008	**-0.006**

Notes: negative values indicate expansion, or uplift in Table 1.

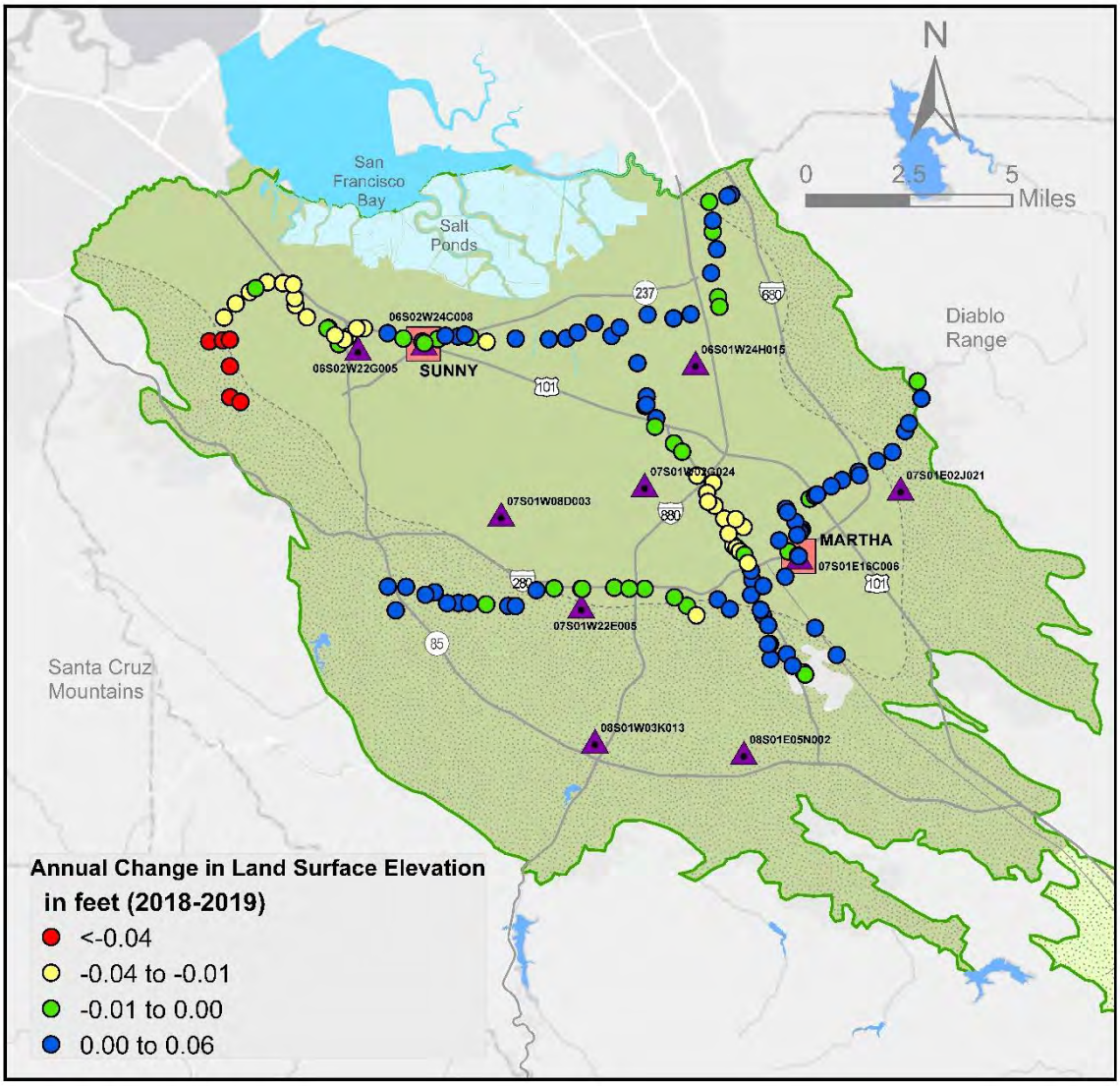
Benchmark survey data analysis

The benchmark survey data along the Los Altos, Alum Rock, and Guadalupe CVLCs are used to study spatial land subsidence conditions and annual changes throughout the Santa Clara Plain. The benchmark survey is conducted in the fall of each year. Figure 1 shows benchmark locations along the three CVLCs surveyed in 2019. Related analysis is summarized below.

Change in land surface elevation from 2018 to 2019: As discussed above, 2019 groundwater elevations remained relatively high throughout the Santa Clara Plain. Figure 5 shows the annual change in land surface elevation from 2018 to 2019 at benchmarks along the Los Altos, Alum Rock, and Guadalupe circuits. For benchmark survey data, a positive value indicates an increase in land surface elevation (uplift) and a negative value indicates a decrease in land surface elevation (subsidence); this is the opposite of the extensometer data.

The 2019 survey data showed a trend of positive land surface elevation changes (uplift) from 2018 at the majority of benchmarks (Figure 5). However, some relatively minor compaction was observed along the western portion of Los Altos circuit, central portion of the Guadalupe circuit, and western portion of the Alum Rock circuit (Figure 5).

Figure 5. Land surface elevation change at benchmarks between 2018 and 2019.



Notes: positive values indicate land surface uplift and negative values indicate land surface subsidence in Figure 5.

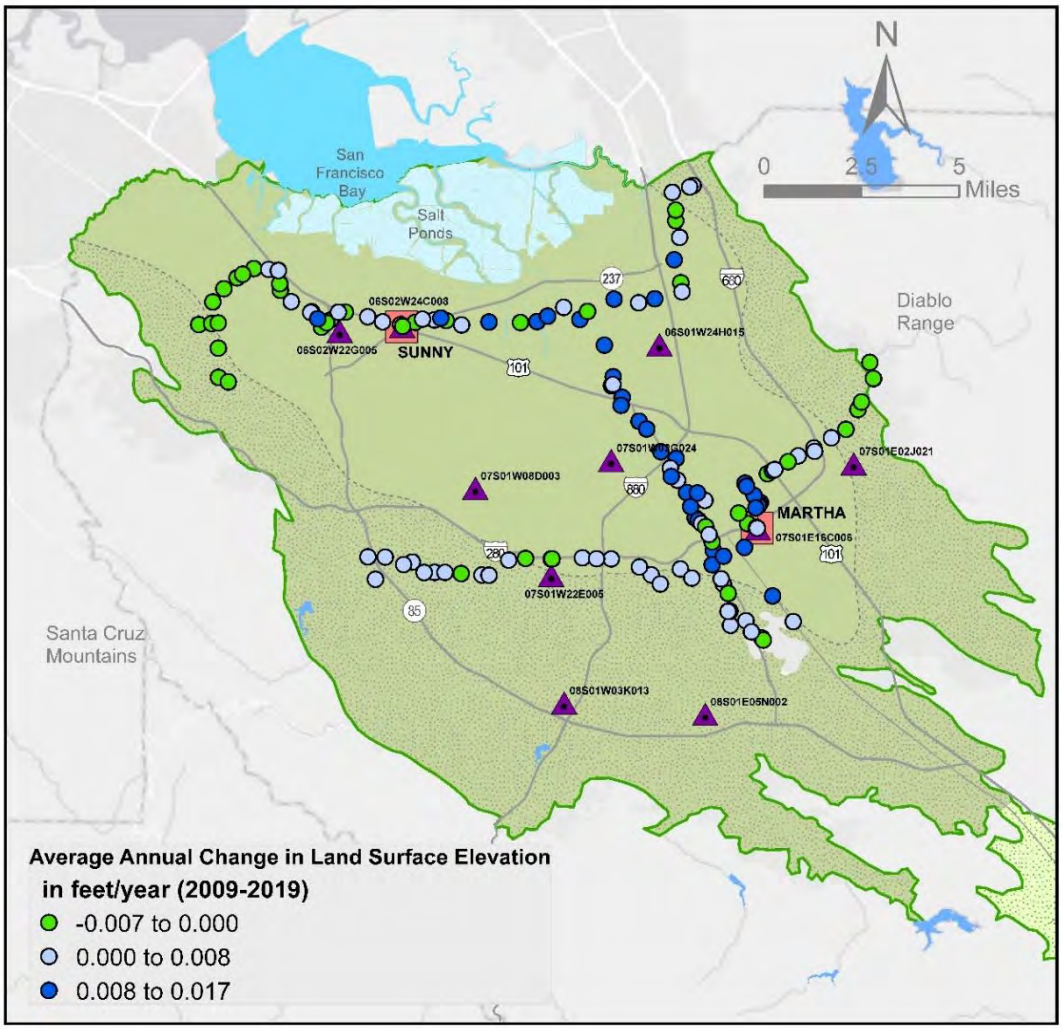
Table 2 summarizes the average and range of annual change of land surface elevation from 2018 to 2019. The average annual change of land surface elevation along each of the three survey circuits in 2019 is close to zero. The risk of land subsidence of 2019 was low.

Table 2. Fall 2019 change in land surface elevation for benchmark circuits compared to Fall 2018.

Survey Circuit	Average Change (feet)	Range (feet)	Number of Benchmarks
Los Altos	-0.01	-0.08 to 0.02	39
Alum Rock	0.02	-0.02 to 0.06	49
Guadalupe	0.00	-0.04 to 0.02	50

Long-term change in land surface elevation: The average annual change of land surface elevation over the last 11 years from 2009 to 2019 at individual benchmarks is presented in Figure 6. Although land surface elevations at some benchmarks increased or decreased at higher values in some years, the average annual change at most benchmarks was within the range of -0.01 to 0.01 feet/year, which is less than the Valley Water's tolerable rate of 0.01 feet/year subsidence.

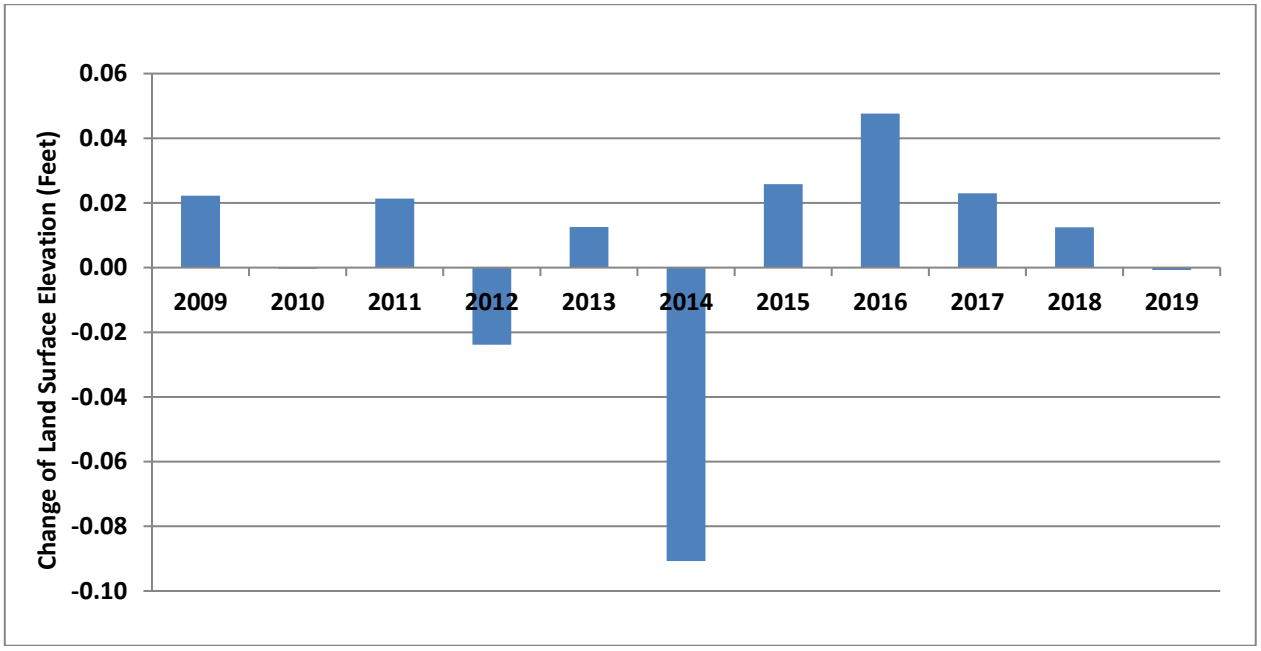
Figure 6. Average annual change of land surface elevation at benchmarks between 2009 and 2019.



Notes: positive values indicate land surface uplift and negative values indicate land surface subsidence in Figure 6.

Figure 7 shows the average annual change in land surface elevation at all benchmarks over the last 11 years from 2009 to 2019. During this 11-year period, there were seven years with positive values (uplift) and four years with negative values (subsidence). The highest annual subsidence was in 2014 and highest annual uplift was in 2016. The average annual ground surface elevation change over the last eleven years is 0.00 feet, indicating no net change.

Figure 7. Average annual change of land surface elevation of all benchmarks from 2009 to 2019.



In summary, the benchmark survey data show a slight land surface uplift along the three CVLCs corresponding with relatively high and stable groundwater elevations in 2019. The risk of land subsidence in 2019 was low, and about same as 2018. The average annual change of land surface elevation in the last 11 years at all benchmarks is 0.00 feet, which corroborates closely to the extensometer data.

Discussion

As shown in Figure 1, the current land subsidence monitoring network consists of two extensometers, 138 benchmarks along three CVLCs, and ten subsidence groundwater monitoring wells, covering most of the Santa Clara Plain. The extensometers monitor subsidence conditions at two sites with high-quality subsidence and water elevation data. The annual survey provides data representing the subsidence condition at benchmarks along three CVLCs. The monitoring of water elevations at subsidence index wells does not provide data to quantify the subsidence condition directly, but the monitoring is straightforward and related data can be used as an indicator for subsidence condition. Since the index wells are located throughout the Santa Clara Plain, the monitoring data reflects regional conditions.

The current Valley Water practice of evaluating the land subsidence condition in the Santa Clara Plain is to calculate the average over an 11-year period using subsidence data collected at two extensometers (Sunny and Martha) and compare it with the established, tolerable rate of land subsidence. The

tolerable subsidence rate of 0.01 feet/year is based on the arithmetic average of historic subsidence and rebound measured in the Sunny and Martha extensometers for the 11-year period from 1980 to 1990 (GEOSCIENCE, 1991). Re-evaluation of the tolerable subsidence rate may be warranted to ensure the rate remains aligned with local groundwater management goals.

The subsidence thresholds established at ten index wells are used as the minimum water elevations that should be maintained to avoid further permanent land subsidence. Although the thresholds were established more than twenty years ago, they were based on a thorough study of historical data, subsidence modeling, and previous studies. It is recommended to continue to use these thresholds for groundwater operations and early indication of potential concerns. Because these thresholds are based on the 0.01 feet/year tolerable subsidence rate, they should be re-evaluated if the tolerable subsidence rate changes or if other information indicates a change is warranted.

The annual survey at benchmarks provides direct measurement of land surface changes along three CVLCs in the Santa Clara Plain. Valley Water will consider whether specific criteria should be developed to analyze survey data.

CONCLUSIONS

In summary, the data measured by each component of the subsidence monitoring network shows that:

- There was little change from 2018 to 2019 in the average groundwater elevations at the ten subsidence index wells. In general, 2019 groundwater elevations were close to or at historical high levels throughout the Santa Clara Plain. Groundwater elevations were higher than the subsidence thresholds at all ten index wells in 2019 in the Santa Clara Plain.
- Net aquifer expansion (or uplift) was measured at both extensometer sites in 2019. The average annual subsidence rate over the last 11 years at the Martha and Sunny sites is -0.006 feet/year, which meets Valley Water's tolerable rate of 0.01 feet/year.
- The benchmark survey data showed that the land surface elevation in 2019 was similar to 2018, the average annual change of land surface elevation over last 11 years was 0.00 feet (no net change).

The analysis of the data collected through the Valley Water subsidence monitoring network indicates that the risk of land subsidence in 2019 remains low. Continued monitoring of the subsidence network is recommended to detect early signs of inelastic land subsidence and to support sustainable groundwater supply.

REFERENCES

1. GEOSCIENCE Support Services Incorporated, 1991, Subsidence Threshold in the North County Area of Santa Clara Valley.
2. Santa Clara Valley Water District (SCVWD), 2016, Groundwater Management Plan for the Santa Clara and Llagas Subbasins.
3. Valley Water, 2019, 2018 Subsidence Data Analysis, Technical Memorandum (Memo).

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APPENDIX B

Annual Groundwater Quality Summary Report

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Valley Water

Annual Groundwater Quality Summary

Did you know that groundwater is an essential local water resource, providing about half of the water used in Santa Clara County? The Santa Clara Water District (Valley Water) is committed to ensuring sustainable water supplies now and in the future. Valley Water's 2019 groundwater quality testing indicates generally high groundwater quality. We remain steadfast in our efforts to maintain this level of groundwater quality.

Valley Water works to safeguard groundwater by:

- Replenishing groundwater with local and imported surface water.
- Reducing the demand on groundwater with alternative water sources, water conservation, and water recycling.
- Monitoring groundwater quality and water levels.
- Implementing programs to protect groundwater from contamination.

You can help protect groundwater by:

- Maintaining wells and septic systems and avoiding the use or storage of potential contaminants near wells.
- Conserving water and by raising awareness that activities above ground can affect our largest drinking water reservoir, which is beneath our feet.

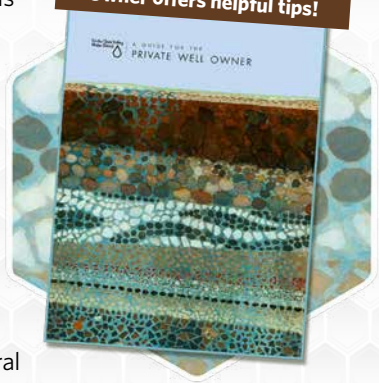
Clean Water • Healthy Environment • Flood Protection

What influences groundwater quality?

As water travels over the land and through the ground, it dissolves naturally occurring minerals and may also pick up substances from animal and human activities, such as:

- Inorganic compounds like salts and metals from natural or industrial sources, animal facilities, farming, and mining.
- Organic chemicals from industrial processes, gas stations, dry cleaners, agricultural uses, and septic systems.
- Insecticides, herbicides, and fertilizers from agricultural and residential uses.
- Viruses and bacteria from sewage treatment plants, sewer lines, septic systems, agricultural operations, and wildlife.
- Radioactive elements that are naturally occurring.

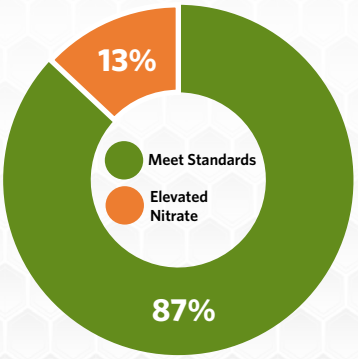
Our Guide for the Private Well Owner offers helpful tips!



How do I know if my water is safe?

State and federal drinking water standards identify contaminant levels that relate to health risk. Public water systems must meet these standards, but domestic wells are not regulated. Valley Water tests regional groundwater quality, but every property and well is unique, so we encourage domestic well owners to regularly test their water. The most common contaminant found in Santa Clara County is nitrate.

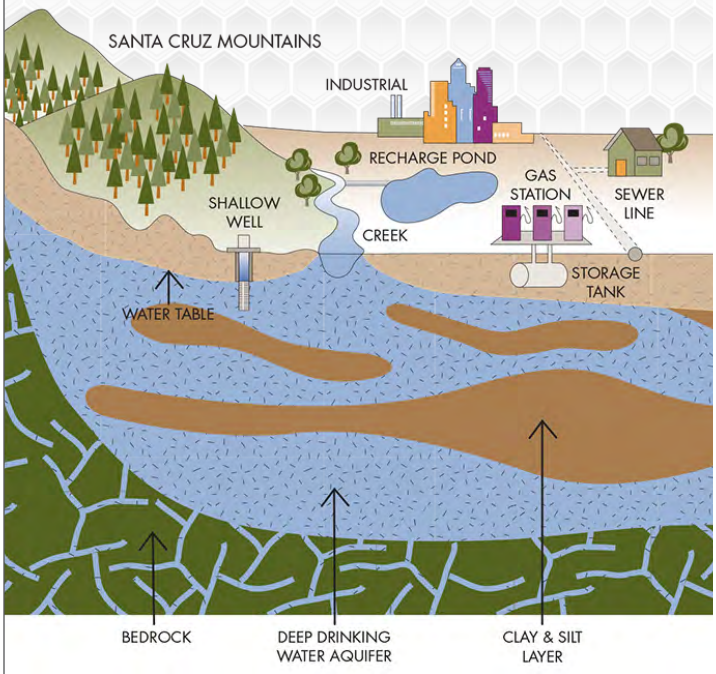
Water Supply Wells Tested Meeting Drinking Water Standards

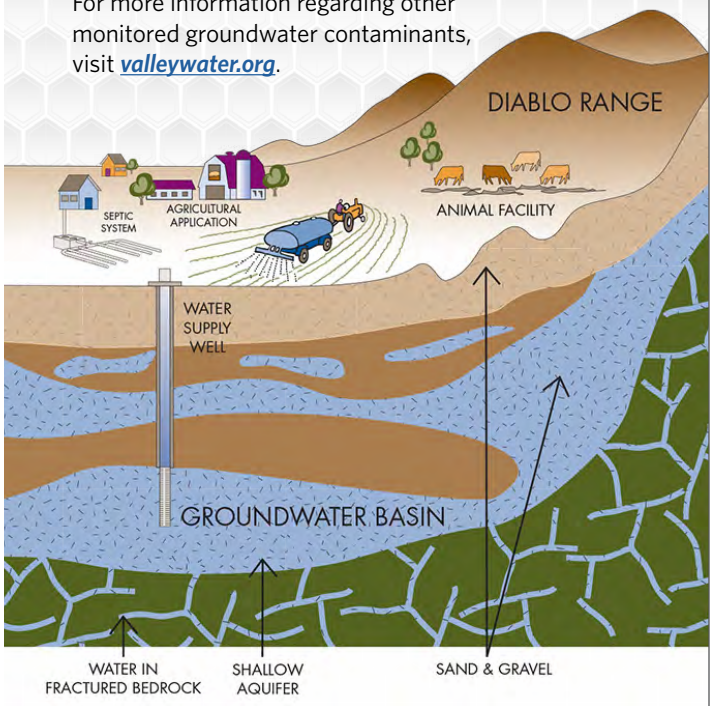


Notes:
1. Graph shows primary drinking water standards.
2. All wells not meeting primary drinking water standards were South County wells with high nitrate (above 10 milligrams per liter).

Nitrate is present above the drinking water standard in many South County domestic wells due to fertilizers, septic systems and livestock waste. Nitrate can interfere with the blood's ability to transport oxygen and is of greatest concern for infants and pregnant women as it can cause serious illness; symptoms include shortness of breath and blueness of the skin.

For more information regarding other monitored groundwater contaminants, visit *valleywater.org*.





	Primary Drinking Water Standards	Units	MCL	Sources	North County Median	North County Range	South County Median	South County Range
Inorganic Contaminants	Aluminum	ppb	1,000	a	16	ND - 200	25	ND - 180
	Arsenic	ppb	10	a,b	ND	ND - 3	ND	ND - 4
	Asbestos	MFL	7	a	--	--	1.0	ND - 1.4
	Barium	ppb	1,000	a	115	ND - 260	79	ND - 190
	Chromium (total)	ppb	50	a,b	2.9	ND - 7.2	1.1	ND - 1.7
	Copper[1]	ppb	1,300	a,c	2	ND - 6.7	1.7	ND - 8.1
	Cyanide	ppb	150	a	ND	ND - 77	ND	ND
	Fluoride (Natural Source)	ppm	2	a	0.12	ND - 0.29	0.13	ND - 0.67
	Lead[1]	ppb	15	a,b,c	ND	ND - 4.6	ND	ND - 1.0
	Nickel	ppb	100	a,b	ND	ND - 1.3[3]	ND	ND - 7.1
	Nitrite (as N)	ppb	1	a,d	ND	ND	ND	ND - 0.5
	Nitrate + Nitrite (as N)	ppm	10	a,d	2.8	0.93 - 5.7	1.2	ND - 4.6
	Nitrate (as N)	ppm	10	a,d	3.1	ND - 8.7	5.8	ND - 42
	Perchlorate	ppb	6	e	ND	ND	ND	ND - 4.8
	Selenium	ppb	50	a	ND	ND - 5.4	ND	ND - 7.0
Radioactive Contaminants	Gross Alpha	pCi/L	15	a	ND	ND - 6.5	1.5	0.72 - 3.3
	Strontium-90	pCi/L	8	a	0.14	0.14	--	--
Volatile Organic Compounds	1,1,1-Trichloroethane (1,1,1-TCA)	ppb	200	b,f	ND	ND - 1.3	ND	ND
	1,1-Dichloroethene (1,1-DCE)	ppb	6	b	ND	ND - 0.78	ND	ND
	Tetrachloroethene (PCE)	ppb	5	b,f	ND	ND	ND	ND - 2.4
	Total Trihalomethanes (THMs)	ppb	80	g	ND	ND - 7.08	--	--
					Present	Absent	Present	Absent
Microbiological Contaminants[2]	E. Coli Bacteria	P/A	--	h	0	12	5	135
	Total Coliform Bacteria	P/A	--	i	4	8	39	101
	Secondary Drinking Water Standards	**Units**	**MCL**	**Sources**	**Median**	**Range**	**Median**	**Range**
	Chloride	ppm	250	a,j	48	31 - 83	50	14 - 155
	Color	Color units	15	a	ND	ND - 7	3	ND - 5
	Iron	ppb	300	a,b	56	ND - 2,100	ND	ND - 2,800
	Manganese	ppb	50	a,b	ND	ND - 84.1	ND	ND - 150
	Odor Threshold	TON	3	a	ND	ND - 4	ND	ND
	pH	pH units	6.5 - 8.5	a,k	7.7	6.5 - 8.7	7.4	6.7 - 8.0
	Specific Conductance	uS/cm	900	a,j	700	139 - 1,100	632	422 - 1,260
	Sulfate	ppm	250	a,b	44	8 - 120	38	ND - 214
	Total Dissolved Solids (TDS)	ppm	500	a	410	272 - 660	396	22 - 1,640
	Turbidity	NTU	5	l	0.21	ND - 3.4	0.24	ND - 2.6
	Zinc	ppb	5,000	a,b	13	ND - 19	7.2	ND - 57

Water Quality Summary

In 2019, Valley Water sampled over 160 domestic wells and evaluated data from over 225 public water supply wells. Nearly all wells tested meet drinking water standards except for nitrate in some South County domestic wells.

This table summarizes results for detected parameters that have a drinking water standard. Not every well was tested for all substances listed. Comprehensive results are reported in the most recent Annual Groundwater Report at *valleywater.org*. Maximum Contaminant Levels (MCLs) apply only to public water systems but are useful guidelines for domestic wells. This regional summary may not reflect the water quality in individual wells since every property and well is unique.

Table Notes

1) Lead and copper do not have MCLs but have "action levels" as shown, and are regulated by the state for public water systems since they can adversely affect public health.

2) Public water systems are required to ensure that fewer than 5% of samples per month have total coliform present and that no samples have e. coli present. Domestic wells are not subject to these standards.

3) One high nickel result (41 ppb) was not confirmed by follow-up testing. The next highest level measured was 1.3 ppb as shown.

Table Terms and Definitions

Maximum Contaminant Level (MCL): the highest level of a contaminant allowable in public water systems. Primary MCLs are health-based regulatory standards. Secondary MCLs are aesthetic standards and relate to the taste, odor, or appearance of drinking water.
Median: the "middle" value of the results, with half of the values above the median and half of the values below the median.
--: indicates there is no related drinking water standard or that the substance was not tested or detected.
MFL: million fibers per liter
ND: not detected (at laboratory reporting limit)
ppm: parts per million (milligrams per liter)
ppb: parts per billion (micrograms per liter)
pCi/L: picoCuries per liter (a measure of radiation)
TON: threshold odor number
pH units: measure of pH
uS/cm: microSiemens per centimeter (a measure of the dissolved inorganic salt content)
NTU: nephelometric turbidity units

Typical Sources for Listed Substances

a: Erosion of natural deposits
b: Discharge of industrial and manufacturing wastes
c: Internal corrosion of household water plumbing systems
d: Agricultural runoff and leaching of fertilizers, septic tanks, and sewage
e: Solid rocket propellant, fireworks, explosives, flares, matches, and other industrial sources
f: Industrial process, dry cleaners, automotive repair shops, leaking underground fuel tanks, and other industrial sources
g: Drinking water chlorination
h: Human and animal fecal wastes
i: Naturally occurring in environment
j: Seawater influence
k: Carbon dioxide emissions; rainfall
l: Soil runoff

You live on a groundwater basin.

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Valley Water Programs for Well Owners

Individual well owners are responsible for making sure their water is safe to drink, but Valley Water offers several programs to help.

Domestic Well Testing
Valley Water offers free water quality testing for eligible Santa Clara County domestic well users. Testing includes common contaminants like nitrate and bacteria.

Nitrate Treatment Rebates
To reduce exposure to elevated nitrate, Valley Water offers rebates of up to $500 to domestic well owners for nitrate treatment systems. Certain restrictions apply.

For more program information, visit ***valleywater.org*** or call the Groundwater Hotline at (408) 630-2300.

Additional Resources

For more information about contaminants and potential health effects, the following resources are available:

- U.S. Environmental Protection Agency's Safe Drinking Water Hotline at (800) 426-4791
- California Division of Drinking Water (*www.waterboards.ca.gov/drinking_water/programs*)
- Your healthcare provider

Contact Us information

For more information, contact **Victoria Garcia** at **(408) 630-3136** or by e-mail at ***VGarcia@valleywater.org***. To find out the latest information on Valley Water projects or to submit questions or comments, use our **Access Valley Water** customer request system at ***https://delivr.com/2yukx***.

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APPENDIX C
2019 Groundwater Quality Results

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Table C-1 Summary of 2019 Water Quality Indicator Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]									
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Aggressive Index (Corrosivity)	Index	1	13	13	13	52	11	12	13	4	12	12	12	--	--
Total Alkalinity (as CaCO3)	mg/L	20	179	265	592	75	135	240	360	9	160	197	287	--	--
Carbonate Alkalinity (as CaCO3)	mg/L	1	<2	<2	<2	27	<2	<2	2.2	1	<2	<2	<2	--	--
Hydroxide Alkalinity (as CaCO3)	mg/L	1	<2	<2	<2	27	<2	<2	<10	1	<2	<2	<2	--	--
Caffeine	ug/L	2	<0.05	<0.05	<0.05	38	<0.05	<0.05	<0.05	2	<0.05	<0.05	<0.05	--	--
Color	Color Units	1	<3	<3	<3	27	<3	<3	7	1	<3	<3	<3	--	15
Dissolved Oxygen	mg/L	18	1.3	2.9	9.2	19	1.3	2.8	9.2	5	1.5	4.4	6.4	--	--
E. Coli (P/A)	P/A	1	0	1		2	0	2		15	0	15		--	--
Foaming Agents (MBAS)	ug/L	1	<0.1	<0.1	<0.1	27	<0.05	<0.1	<0.1	1	<0.10	<0.10	<0.10	--	500
Hardness (Total, as CaCO3)	mg/L	20	176	335	681	77	78	300	450	24	152	265	544	--	--
Langelier Index @ 60 C	Index	1	1.1	1.1	1.1	29	0.32	1.1	1.4	2	0.42	0.61	0.8	--	--
Odor Threshold @ 60 C	TON	--	--	--	--	54	<1	<1	4	4	<1	<1	<1	--	3
Oxidation Reduction Potential (ORP)	mV	19	-74	60	197	19	-130	77	186	5	-27	114	217	--	--
pH	pH Units	20	6.4	7.2	7.8	87	6.5	7.6	8.7	9	6.5	7.4	7.9	--	6.5 - 8.5
Source Temperature	C	19	14	20	26	31	18	20	28	5	18	19	27	--	--
Specific Conductance	uS/CM	38	497	805	1,510	96	139	670	1,100	14	526	580	883	--	900
Total Organic Carbon (TOC)	mg/L	--	--	--	--	3	<0.3	<0.3	<0.3	--	--	--	--	--	--
Turbidity	NTU	37	<0.01	0.25	7.8	94	<0.1	0.25	22	14	<0.10	0.20	2.6	--	5
Total Coliform (P/A) [9]	P/A	1	1 Present	0 Absent		2	1 Present	1 Absent		15	2 Present	13 Absent		--	--

Table C-1 Summary of 2019 Water Quality Indicator Data

Parameter	Units[1]	Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Aggressive Index (Corrosivity)	Index	--	--	--	--	6	12	12	13	--	--
Total Alkalinity (as CaCO3)	mg/L	18	105	205	346	27	98	201	352	--	--
Bicarbonate Alkalinity (as CaCO3)	mg/L	1	214	214	214	1	322	322	322	--	--
Color	Color Units	--	--	--	--	1	5	5	5	--	15
Dissolved Oxygen	mg/L	18	1.7	5.2	9.5	19	1.9	5.6	8.6	--	--
E. Coli (MPN)	MPN/100mL	2	<1	<1	<1	2	<1.0	<1.0	<1.0	--	--
E. Coli (P/A)	P/A	15	1	14		37	0	37		--	--
Foaming Agents (MBAS)	ug/L	2	<0.10	<0.10	<0.10	2	<0.03	<0.10	<0.10	--	500
Hardness (Total, as CaCO3)	mg/L	29	91	306	571	49	29	256	510	--	--
Heterotrophic Plate Count	CFU/ml	2	480	490	500	2	320	330	340	--	--
Langelier Index @ 60 C	Index	--	--	--	--	1	0.6	0.6	0.6	--	--
Odor Threshold @ 60 C	Index	--	--	--	--	6	<1.0	<1.0	<1.0	--	3
Oxidation Reduction Potential (ORP)	mV	18	11	145	240	19	-56	123	239	--	--
pH	pH Units	18	6.6	6.9	7.5	27	6.7	7.4	8.9	--	6.5 - 8.5
Source Temperature	C	18	18	20	24	19	18	21	30	--	--
Specific Conductance	uS/CM	35	337	684	1,160	66	460	626	1,260	--	900
Total Coliform (MPN)	MPN/100mL	2	<1	<1	<1	2	<1.0	<1.0	<1.0	--	--
Total Organic Carbon (TOC)	mg/L	--	--	--	--	1	<0.30	<0.30	<0.30	--	--
Turbidity	NTU	31	<0.10	0.5	5.8	42	<0.10	0.3	5.0	--	5
Total Coliform (P/A)[9]	P/A	15	7 Present	8 Absent		37	8 Present	29 Absent		--	--

Table C-1 Summary of 2019 Water Quality Indicator Data (Notes)

Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. ug/L = micrograms per liter; mg/L = milligrams per liter; P/A = present/absent per 100 ml; uS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units; TON = Threshold Odor Number
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results reported at multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed first with the upper threshold in parentheses.
9. Total coliform and e. coli bacteria are regulated under the US EPA Total Coliform Rule, which identifies sampling requirements and compliance criteria based on the type of public water system. All wells with data in bacteria results in this table are private, domestic wells that are not subject to federal or state drinking water requirements.

Table C-2 Summary of 2019 Inorganic Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]									
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Major and Minor Ions															
Bicarbonate (as HCO3)	mg/L	20	218	336	722	75	165	290	450	9	195	241	350	--	--
Bromide	mg/L	19	<0.1	0.2	0.4	25	<0.1	0.16	0.24	19	<0.1	0.16	1.8	--	--
Calcium	mg/L	20	37	74	156	75	16	66	131	10	7.5	48	81	--	--
Calcium (as CaCO3)	mg/L	19	91	190	390	19	40	139	328	5	19	124	155	--	--
Carbon Dioxide	ug/L	1	8,300	8,300	8,300	45	4.2	1,793	11,000	1	4,500	4,500	4,500	--	--
Chloride	mg/L	20	23	55	86	75	10	46	83	9	14	43	85	--	250
Cyanide	ug/L	1	<100	<100	<100	39	<2	<5	77	3	<100	<100	<100	150	
Fluoride (natural source)	mg/L	20	<0.1	0.1	0.6	86	<0.05	0.12	0.3	22	<0.1	0.14	0.26	2	--
Magnesium	mg/L	20	11	38	71	75	7.2	28	65	10	28	34	61	--	--
Perchlorate	ug/L	20	<4	<4	<4	55	<2	<4	<4	9	<4	<4	<4	6	--
Potassium	mg/L	20	0.6	1.3	2.3	70	<1	1.3	4.1	8	<1	1.2	1.9	--	--
Sodium	mg/L	20	22	40	163	75	15	31	106	10	17	28	104	--	--
Sodium Adsorption Ratio	ratio	20	0.64	1.1	4.4	74	0.53	0.9	5.9	9	0.52	0.9	3.3	--	--
Sulfate	mg/L	20	25	59	359	77	6.4	44	120	23	<0.5	42	104	--	250
Total Dissolved Solids (TDS)	mg/L	20	304	451	1,020	77	238	410	660	29	256	384	1,640	--	500
Nutrients															
Ammonia (NH3-N)	mg/L	--	--	--	--	3	<0.05	<0.05	<0.05	--	--	--	--	--	--
Nitrate (as N)	mg/L	20	<0.1	0.8	5.3	272	<0.1	3.1	9.1	40	<0.1	4.2	18	10	--
Nitrate + Nitrite (as N)	mg/L	1	3.7	3.7	3.7	55	0.93	2.8	5.7	6	0.5	0.73	1.6	10	--
Nitrite (as N)	mg/L	1	<0.4	<0.4	<0.4	65	<0.05	<0.4	<0.4	7	<0.4	<0.4	<0.4	1	--
Orthophosphate (as PO4)	mg/L	19	<0.1	0.2	1.3	24	<0.1	0.1	1.6	19	<0.1	<0.1	0.5	--	--
Trace Elements															
Aluminum	ug/L	20	<20	25	39	87	<20	25	200	8	<20	20.5	180	1,000	200
Antimony	ug/L	20	<1	<1	<6	81	<0.5	<6	<6	8	<1	<1	<6	6	--
Arsenic	ug/L	20	<2	<2	10	82	<2	<2	5	8	<2	<2	2	10	--
Asbestos	MFL	--	--	--	--	1	<0.2	<0.2	<0.2	--	--	--	--	7	--
Barium	ug/L	20	35	120	320	81	<100	110	270	8	<100	93	260	1,000	--
Beryllium	ug/L	20	<1	<1	<1	81	<0.5	<1	<1	8	<1	<1	<1	4	--
Boron	ug/L	19	88	170	702	22	<100	128	282	5	<50	112	150	--	--
Cadmium	ug/L	20	<1	<1	<1	82	<0.2	<1	<1	8	<1	<1	<1	5	--
Chromium	ug/L	20	<1	<1	3	84	<1	1.6	9	8	<1	1.6	4	50	--
Chromium 6 (Hexavalent)	ug/L	19	<1	<1	3.1	34	<1	1.2	10	7	<1	1.8	5.3	--	--
Cobalt	ug/L	19	<1	<1	<1	24	<1	<1	0	5	<1	<1	<1	--	--
Copper[9]	ug/L	20	<1	<1	2	84	<1	<1	6.7	9	<1	<1	<50	1,300	1,000
Iron	ug/L	20	<20	<20	150	132	<20	22	2,100	13	<20	<20	360	--	300
Lead[9]	ug/L	20	<1	<1	<5	84	<1	<1	5	8	<1	<1	<5	15	--
Lithium	ug/L	19	<5	7.2	21	22	<5	6.8	29	5	9.4	11	25	--	--
Manganese	ug/L	20	<1	19	988	94	<1	13	143	9	<1	1.4	107	--	50
Mercury	ug/L	20	<1	<1	<1	80	<0.2	<1	<1	8	<1	<1	<1	2	--
Molybdenum	ug/L	19	<1	2.1	27	24	<1	0.82	13	5	<1	<1	12	--	--
Nickel	ug/L	20	<1	<1	2	83	<1	<10	41	8	<1	<1	<10	100	--
Selenium	ug/L	20	<5	<5	<5	81	<2	1.6	6	8	<5	<5	<5	50	--
Silica	mg/L	19	20	24	35	22	19	28	41	5	22	23	40	--	--
Silver	ug/L	20	<1	<1	<10	75	<1	<10	<10	9	<1	<1	<10	--	100
Thallium	ug/L	20	<1	<1	<1	82	<0.5	<1	<1	8	<1	<1	<1	2	--
Vanadium	ug/L	19	<1	1.8	3.9	25	<1	1.8	8.9	5	<1	1.4	9.2	--	--
Zinc	ug/L	20	<10	<10	28	78	<10	<10	24	9	<10	<10	12	--	5,000

Table C-2 Summary of 2019 Inorganic Data

Parameter	Units[1]	Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone				Principal Zone					
		n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Major and Minor Ions											
Bicarbonate (as HCO3)	mg/L	17	128	250	422	24	120	245	430	--	--
Bromide	mg/L	29	<0.1	0	0.38	43	<0.1	0	0.7	--	--
Calcium	mg/L	18	38	61	102	27	3	53	100	--	--
Calcium (as CaCO3)	mg/L	18	95	152	256	19	87	138	250	--	--
Chloride	mg/L	18	9	46	79	26	17	48	155	--	250
Cyanide	ug/L	2				11		<100	<100	150	
Fluoride (natural source)	mg/L	29	<0.1	0.1	0.61	51	<0.1	0.1	0.47	2	--
Magnesium	mg/L	18	21	38	77	25	20	31	56	--	--
Perchlorate	ug/L	18	<4	<4	<4	52	<2	<2	4.8	6	--
Potassium	mg/L	18	<0.5	1	2.1	23	<0.5	1	1.9	--	--
Sodium	mg/L	18	12	27	78	26	14	31	110	--	--
Sodium Adsorption Ratio	ratio	17	0.40	1	2.0	24	0.35	1	4.0	--	--
Sulfate	mg/L	29	8.7	37	214	50	3.9	42	96	--	250
Total Dissolved Solids (TDS)	mg/L	29	214	384	834	51	254	404	760	--	500
Nutrients											
Nitrate (as N)	mg/L	29	<0.1	6	52	170	<0.4	5	42	10	--
Nitrate + Nitrite (as N)	mg/L	--	--	--	--	10	<0.4	4	4.6	10	--
Nitrite (as N)	mg/L	--	--	--	--	20	<0.4	<0.4	0.5	1	--
Orthophosphate (as PO4)	mg/L	28	<0.1	<0.1	1.1	42	<0.1	<0.1	1	--	--
Trace Elements											
Aluminum	ug/L	18	<20	23	37	27	<20	24	44	1,000	200
Antimony	ug/L	18	<1	<1	<1	27	<1	<1	<6	6	--
Arsenic	ug/L	18	<2	<2	<2	27	<2	<2	4	10	--
Asbestos	MFL	--	--	--	--	3	<0.2	1	1.4	7	--
Barium	ug/L	18	11	120	380	27	<100	95	490	1,000	--
Beryllium	ug/L	18	<1	<1	<1	27	<1	<1	<1	4	--
Boron	ug/L	18	<50	110	180	23	<50	95	262	--	--
Cadmium	ug/L	18	<1	<1	<1	27	<1	<1	<1	5	--
Chromium	ug/L	18	<1	1	4.4	27	<1	1	2.5	50	--
Chromium 6 (Hexavalent)	ug/L	16	<1	<1	4.3	17	<1	1	1.9	--	--
Cobalt	ug/L	18	<1	<1	<1	19	<1	<1	<1	--	--
Copper[9]	ug/L	18	<1	<1	8.1	27	<1	2	7.3	1,300	1,000
Iron	ug/L	18	<20	<20	350	30	<20	9	2,800	--	300
Lead[9]	ug/L	18	<1	<1	1.1	29	<1	<1	<5	15	--
Lithium	ug/L	18	<5	8	32	19	<5	10	26	--	--
Manganese	ug/L	18	<1	<1	37	26	<1	1	150	--	50
Mercury	ug/L	18	<1	<1	<1	27	<1	<1	<1	2	--
Molybdenum	ug/L	18	<1	<1	1.1	19	<1	<1	4.5	--	--
Nickel	ug/L	18	<1	1	2.3	27	<1	<1	7	100	--
Selenium	ug/L	18	<5	<5	6	27	<5	<5	7	50	--
Silica	mg/L	18	21.4	29	43	21	22	28	51	--	--
Silver	ug/L	18	<1	<1	<1	25	<1	<1	<10	--	100
Thallium	ug/L	18	<1	<1	<1	27	<1	<1	<1	2	--
Vanadium	ug/L	18	<1	2	14	19	<1	2	12	--	--
Zinc	ug/L	18	<10	<10	120	25	<10	6	95	--	5,000

Table C-2 Summary of 2019 Inorganic Data (Notes)

Table includes data for wells monitored by the Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. mg/L = milligrams per liter; ug/L = micrograms per liter; MFL = million fibers per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed first with the upper threshold in parentheses.
9. Lead and copper do not have primary MCLs but have "action levels" of 15 and 1,300 ppb, respectively. These substances are regulated by the state for public water systems since they can adversely affect public health.

Table C-3 Summary of 2019 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
1,1,1,2-Tetrachlorethane	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,1,1-Trichloroethane	ug/L	13	**D**	0.5	115	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	200	--
1,1,2,2-Tetrachloroethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	1	--
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	ug/L	13	**D**	2	114	**D**	2	8	ND	10	18	ND	2	57	ND	10	1,200	--
1,1,2-Trichloroethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
1,1-Dichloroethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
1,1-Dichloroethene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	6	--
1,1-Dichloropropene	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,2,3-Trichlorobenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,2,3-Trichloropropane	ug/L	12	ND	0.5	179	ND	0.5	19	ND	0.5	18	ND	0.5	54	ND	0.5	0.005	--
1,2,4-Trichlorobenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	--	--
1,2,4-Trimethylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	5	--
1,2-Dichlorobenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	600	--
1,2-Dichloroethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	0.5	--
1,2-Dichloropropane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
1,3,5-Trimethylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,3-Dichlorobenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,3-Dichloropropane	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
1,3-Dichloropropene (Total)	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	0.5	--
cis-1,3-Dichloropropene	ug/L	13	ND	0.5	49	ND	0.5	6	ND	0.5	18	ND	0.5	19	ND	0.5	--	--
trans-1,3,Dichloropropene	ug/L	13	ND	0.5	49	ND	0.5	6	ND	0.5	18	ND	0.5	19	ND	0.5	--	--
1,4-Dichlorobenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
1-Phenylpropane (n-Propylbenzene)	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
2,2-Dichloropropane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
2,4-Dinitrotoluene	ug/L	2	ND	5	35	ND	5	2	ND	5	--	--	--	--	--	--	--	--
2-Chlorotoluene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
4-Chlorotoluene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Benzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	1	--
Benzo (a) Pyrene	ug/L	2	ND	0.1	45	ND	0.1	4	ND	0.1	--	--	--	8	ND	0.1	0.2	--
Bromobenzene	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Bromochloroacetic Acid (BCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--

Table C-3 Summary of 2019 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Bromochloromethane	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Bromodichloroacetic Acid (BDCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Bromodichloromethane (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	ND	1	--	--
Bromoform (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	**D**	1	--	
Bromomethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Carbon Disulfide	ug/L	1	ND	0.5	24	ND	0.5	1	ND	0.5	--	--	--	--	--	--	--	--
Carbon Tetrachloride	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	0.5	--
Chloroethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Chloroform (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	**D**	0.5	20	ND	1	--	--
Chloromethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
cis-1,2-Dichloroethene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	6	--
Di(2-Ethylhexyl) Adipate	ug/L	2	ND	5	45	ND	5	4	ND	5	--	--	--	8	ND	5	400	--
Di(2-Ethylhexyl) Phthalate	ug/L	2	ND	3	45	ND	3	4	ND	3	--	--	--	8	ND	3	4	--
Dibromoacetic Acid (DBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Dibromochloroacetic Acid (CDBAA)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	1	ND	2	--	--
Dibromochloromethane (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	ND	1	--	--
Dibromochloropropane (DBCP)	ug/L	2	ND	0.01	46	ND	0.01	3	ND	0.01	--	--	--	12	ND	0.01	0.2	--
Dibromomethane	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Dichlorodifluoromethane (Freon 12)	ug/L	13	ND	0.5	63	**D**	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Dichloromethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
Diisopropyl Ether	ug/L	13	ND	3	51	ND	3	7	ND	3	18	ND	2	20	ND	3	--	--
Ethylbenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	300	--
Ethylene Dibromide (EDB)	ug/L	2	ND	0.02	--	--	--	3	ND	0.02	--	--	--	12	ND	0.02	0.05	--
Ethylenediamine Tetra-Acetic Acid	mg/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	2	ND	0.1	--	--
Ethyl-Tert-Butyl Ether	ug/L	13	ND	3	63	ND	3	7	ND	3	18	ND	2	20	ND	3	--	--
Hexachlorobutadiene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Isopropylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
m,p-Xylene	ug/L	13	ND	0.5	69	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Methyl Ethyl Ketone (MEK, Butanone)	ug/L	1	ND	0.5	28	ND	5	2	ND	5	--	--	--	1	ND	5	--	--
Methyl Isobutyl Ketone	ug/L	1	ND	0.5	41	ND	5	2	ND	5	--	--	--	1	ND	5	--	--
Methyl Tert-Butyl Ether (MTBE)	ug/L	13	ND	3	119	ND	3	8	ND	3	18	ND	2	57	ND	3	13	5

Table C-3 Summary of 2019 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Monobromoacetic Acid (MBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Monochloroacetic Acid (MCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
Monochlorobenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	70	--
Naphthalene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
n-Butylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
N-Ethyl Perfluorooctanesulfonamidoacetic Acid	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
Nitrilotriacetic Acid (NTA)	mg/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	2	ND	0.1	--	--
N-Methyl Perfluorooctanesulfonamidoacetic Acid	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
n-Nitrosodiethylamine (NDEA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
n-Nitrosodimethylamine (NDMA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
n-Nitrosodi-n-Propylamine (NDPA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
n-Nitrosomethylethylamine (NMEA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
n-Nitrosomorpholine (NMOR)	ng/L	--	--	--	--	--	--	--	--	--	1	ND	2	1	ND	2	--	--
n-Nitrosopiperidine (NPIP)	ng/L	--	--	--	--	--	--	--	--	--	1	ND	2	1	ND	2	--	--
n-Nitrosopyrrolidine (NPYR)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	2	2	ND	2	--	--
o-Xylene	ug/L	13	ND	0.5	69	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
PCB-1016	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
PCB-1221	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
PCB-1232	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
PCB-1242	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
PCB-1248	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
PCB-1254	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	
PCB-1260	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	8	ND	0.5	--	--
Perfluorobutanoic acid (PFBA)	ng/L	--	--	--	--	--	--	--	--	--	1	ND	100	1	ND	10	--	--
Perfluorobutanesulfonic acid (PFBS)	ng/L	--	--	--	98	**D**	2	--	--	--	1	ND	4.1	1	ND	4.3	--	--
Perfluorodecanoic acid (PFDA)	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
Perfluorododecanoic acid (PFDoA)	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
Perfluoroheptanoic acid (PFHPA)	ng/L	--	--	--	98	**D**	3	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexane Sulfonic acid (PFHxS)	ng/L	--	--	--	98	**D**	3	--	--	--	--	--	--	--	--	--	--	--

Table C-3 Summary of 2019 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Perfluorohexanoic acid (PFHxA)	ng/L	--	--	--	98	**D**	3	--	--	--	--	--	--	--	--	--	--	--
Perfluorononanoic acid (PFNA)	ng/L	--	--	--	98	**D**	3	--	--	--	--	--	--	--	--	--	--	--
Perfluorooctanoic acid (PFOA)	ng/L	--	--	--	98	**D**	3	--	--	--	2	**D**	1.6	2	ND	5	--	--
Perfluorooctyl Sulfonate (PFOS)	ng/L	--	--	--	98	**D**	3	--	--	--	2	**D**	5	2	ND	5	--	--
Perfluorotetradecanoic acid (PFTA)	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
Perfluorotridecanoic acid (PFTrDA)	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
Perfluoroundecanoic acid (PFUnA)	ng/L	--	--	--	98	ND	3	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	ug/L	13	ND	0.5	46	ND	0.5	6	ND	0.5	18	ND	0.5	19	ND	0.5	--	--
Polychlorinated Biphenyls (Total PCBs)	ug/L	2	ND	0.5	47	ND	0.5	3	ND	0.5	--	--	--	11	ND	0.5	0.5	--
sec-Butylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Styrene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	100	--
Tert-Amyl Methyl Ether (TAME)	ug/L	13	ND	3	63	ND	3	7	ND	3	18	ND	2	20	ND	3	--	--
Tert-Butyl Alcohol (TBA)	ug/L	12	ND	2	22	ND	2	6	ND	2	18	ND	2	19	ND	2	--	--
Tert-Butylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Tetrachloroethene	ug/L	13	**D**	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	**D**	0.5	5	--
Toluene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	150	--
Total Trihalomethanes	ug/L	1	ND	0.5	31	**D**	0.5	1	ND	0.5	--	--	--	--	--	--	80	--
trans-1,2,Dichloroethene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	10	--
Tribromoacetic Acid (TBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	4	2	ND	4	--	--
Trichloroacetic Acid (TCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Trichloroethene	ug/L	13	ND	0.5	114	**D**	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
Trichlorofluoromethane (Freon 11)	ug/L	13	ND	5	114	ND	5	8	ND	5	18	ND	2.5	57	ND	5	150	--
Vinyl Chloride	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	0.5	--
Xylenes (Total)	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	1,750	--

Notes:

Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented. Unless construction is known, DDW wells are assumed to represent the principal zone, as these are typically deep wells.

1. ug/L = micrograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. ND= not detected above laboratory reporting limit in any samples. D = detection above reporting limit in one or more samples (see Table C-4 for more information).
6. RL = Laboratory reporting limit. In the case of multiple reporting limits, the highest limit is shown. NA is shown if the reporting limit is not available.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

Table C-4 Summary of 2019 Volatile Organic Compounds (VOCs) Detections

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]								Shallow Zone				Principal Zone					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
1,1,1-Trichloroethane	ug/L	13	<0.5	<0.5	0.9	115	<0.5	<0.5	2.4	8	<0.5	<0.5	<0.5	18	<0.5	<0.5	<0.5	57	<0.5	<0.5	<0.5	200	--
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	ug/L	13	<2	<2	2.4	114	<0.5	<2	3.3	8	<2	<2	<10	18	<2	<2	<2	57	<2	<2	<10	1,200	--
1,1-Dichloroethene	ug/L	13	<0.5	<0.5	<0.5	114	<0.5	<0.5	4.6	8	<0.5	<0.5	<0.5	18	<0.5	<0.5	<0.5	57	<0.5	<0.5	<0.5	6	--
Bromodichloromethane (THM)	ug/L	13	<0.5	<0.5	<1	63	<0.5	<1	2.2	7	<0.5	<0.5	<1	18	<0.5	<0.5	<0.5	20	<0.5	<0.5	<1	--	--
Bromoform (THM)	ug/L	13	<0.5	<0.5	<1	63	<0.5	<1	1	7	<0.5	<0.5	<1	18	<0.5	<0.5	<0.5	20	<0.5	<0.5	0.94	--	--
Chloroform (THM)	ug/L	13	<0.5	<0.5	<1	63	<0.5	<1	1.1	7	<0.5	<0.5	<1	18	<0.5	<0.5	6.9	20	<0.5	<0.5	<1	--	--
Dibromochloromethane (THM)	ug/L	13	<0.5	<0.5	<1	63	<0.5	<1	2.8	7	<0.5	<0.5	<1	18	<0.5	<0.5	<0.5	20	<0.5	<0.5	<1	--	--
Dichlorodifluoromethane (Freon 12)	ug/L	13	<0.5	<0.5	<0.5	63	<0.5	<0.5	5	7	<0.5	<0.5	<0.5	18	<0.5	<0.5	<0.5	20	<0.5	<0.5	<0.5	--	--
Perfluorobutanesulfonic acid (PFBS)	ng/L	--	--	--	--	98	<1	<2	3.8	--	--	--	--	1	<4.1	<4.1	<4.1	1	<4.3	<4.3	<4.3	--	--
Perfluoroheptanoic acid (PFHPA)	ng/L	--	--	--	--	98	<1	<2	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexane Sulfonic acid (PFHxS)	ng/L	--	--	--	--	98	<1.7	2.2	8.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexanoic acid (PFHxA)	ng/L	--	--	--	--	98	<0.88	<2	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perfluorononanoic acid (PFNA)	ng/L	--	--	--	--	98	<0.88	<2	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perfluorooctanoic acid (PFOA)	ng/L	--	--	--	--	98	<0.88	<2	3.4	--	--	--	--	2	6.9	8.1	9.3	2	<1.7	<5	<5	--	--
Perfluorooctyl Sulfonate (PFOS)	ng/L	--	--	--	--	98	<0.89	0.89	8.2	--	--	--	--	2	2.2	2.2	2.2	2	<1.7	<5	<5	--	--
Tetrachloroethene	ug/L	13	<0.5	<0.5	0.8	114	<0.5	<0.5	<0.5	8	<0.5	<0.5	<0.5	18	<0.5	<0.5	<0.5	57	<0.5	<0.5	2.4	5	--
Total Trihalomethanes	ug/L	1	<0.5	<0.5	<0.5	31	<0.5	<0.5	7.1	1	<0.5	<0.5	<0.5	--	--	--	--	--	--	--	--	80	--
Trichloroethene	ug/L	13	<0.5	<0.5	<0.5	114	<0.5	<0.5	0.7	8	<0.5	<0.5	<0.5	18	<0.5	<0.5	<0.5	57	<0.5	<0.5	<0.5	5	--

Notes:

Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW). The table does not include results from wells sampled near recycled water irrigation sites, which are included in Appendix E.

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. ug/L = micrograms per liter; ng/L = nanograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.
9. Verification sampling did not confirm the high 1,2,3-Trichloropropane result. All subsequent results were below the detection level (0.005 ppb).

Table C-5 Summary of 2019 Pesticide Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
2,3,7,8-TCDD (Dioxin)	pg/L	2	ND	5	46	ND	5	3	ND	5	--	--	--	8	ND	5	30	--
2,4,5-TP (Silvex)	ug/L	--	--	--	48	ND	1	3	ND	1	--	--	--	8	ND	1	50	--
2,4-D	ug/L	2	ND	10	48	ND	10	3	ND	10	--	--	--	8	ND	10	70	--
3-Hydroxycarbofuran	ug/L	2	ND	3	42	ND	3	3	ND	3	--	--	--	2	ND	3	--	--
Aciflurfen	ug/L	--	--	--	6	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Alachlor	ug/L	2	ND	1	55	ND	1	6	ND	1	--	--	--	9	ND	1	2	--
Aldicarb	ug/L	2	ND	3	42	ND	3	3	ND	3	--	--	--	2	ND	3	--	--
Aldicarb Sulfone	ug/L	2	ND	4	42	ND	4	3	ND	4	--	--	--	2	ND	4	--	--
Aldicarb Sulfoxide	ug/L	2	ND	3	42	ND	3	3	ND	3	--	--	--	2	ND	3	--	--
Aldrin	ug/L	2	ND	0.08	42	ND	0.08	2	ND	0.08	--	--	--	1	ND	0.08	--	--
Atrazine	ug/L	2	ND	0.5	48	ND	0.5	5	ND	0.5	--	--	--	9	ND	0.5	1	--
Bentazon	ug/L	2	ND	2	48	ND	2	3	ND	2	--	--	--	8	ND	2	18	--
Bromacil	ug/L	2	ND	10	39	ND	10	3	ND	10	--	--	--	--	--	--	--	--
Butachlor	ug/L	2	ND	0.38	39	ND	0.38	3	ND	0.38	--	--	--	--	--	--	--	--
Carbaryl	ug/L	2	ND	5	42	ND	5	3	ND	5	--	--	--	2	ND	5	--	--
Carbofuran	ug/L	2	ND	5	48	ND	5	4	ND	5	--	--	--	12	ND	5	18	--
Chlordane	ug/L	2	ND	0.1	47	ND	0.1	3	ND	0.1	--	--	--	11	ND	0.1	0.1	--
Dalapon	ug/L	2	ND	10	47	ND	10	3	ND	10	--	--	--	8	ND	10	200	--
DCPA (Total Di & Mono Acid Degradates)	ug/L	2	ND	0.1	38	ND	0.1	2	ND	0.1	--	--	--	--	--	--	--	--
Diazinon	ug/L	2	ND	0.1	38	ND	0.1	2	ND	0.1	--	--	--	--	--	--	--	--
Dicamba	ug/L	2	ND	1.5	48	ND	1.5	3	ND	1.5	--	--	--	4	ND	1.5	--	--
Dieldrin	ug/L	2	ND	0.02	41	ND	0.02	2	ND	0.02	--	--	--	1	ND	0.02	--	--
Dimethoate	ug/L	2	ND	0.1	38	ND	0.1	2	ND	0.1	--	--	--	--	--	--	--	--
Dinoseb	ug/L	2	ND	2	48	ND	2	3	ND	2	--	--	--	8	ND	2	7	--
Diquat	ug/L	1	ND	4	36	ND	4	3	ND	4	--	--	--	--	--	--	20	--
Endothall	ug/L	2	ND	45	47	ND	45	4	ND	45	--	--	--	11	ND	45	100	--
Endrin	ug/L	2	ND	0.1	47	ND	0.1	3	ND	0.1	--	--	--	11	ND	0.1	2	--
gamma-BHC (lindane)	ug/L	2	ND	0.2	54	ND	0.2	4	ND	0.2	--	--	--	11	ND	0.2	0.2	--
Glyphosate	ug/L	2	ND	25	46	ND	25	4	ND	25	--	--	--	14	ND	25	700	--
Heptachlor	ug/L	2	ND	0.01	47	ND	0.01	3	ND	0.01	--	--	--	11	ND	0.01	0.01	--
Heptachlor Epoxide	ug/L	2	ND	0.01	47	ND	0.01	3	ND	0.01	--	--	--	11	ND	0.01	0.01	--
Hexachlorobenzene	ug/L	2	ND	0.5	47	ND	0.5	--	--	--	--	--	--	11	ND	0.5	1	--

Table C-5 Summary of 2019 Pesticide Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Hexachlorocyclopentadiene	ug/L	2	ND	1	47	ND	1	3	ND	1	--	--	--	11	ND	1	50	--
Methiocarb	ug/L	2	ND	0.5	41	ND	0.5	2	ND	0.5	--	--	--	--	--	--	--	--
Methomyl	ug/L	2	ND	2	--	--	--	3	ND	2	--	--	--	2	ND	2	--	--
Methoxychlor	ug/L	2	ND	10	54	ND	10	4	ND	10	--	--	--	11	ND	10	30	--
Metolachlor	ug/L	2	ND	0.05	38	ND	0.05	2	ND	0.05	--	--	--	--	--	--	--	--
Metribuzin	ug/L	2	ND	0.05	38	ND	0.06	2	ND	0.05	--	--	--	--	--	--	--	--
Molinate	ug/L	2	ND	2	48	ND	2	4	ND	2	--	--	--	8	ND	2	20	--
Oxamyl	ug/L	2	ND	20	48	ND	20	4	ND	20	--	--	--	12	ND	20	50	--
Pentachlorophenol	ug/L	2	ND	0.2	48	ND	0.2	3	ND	0.2	--	--	--	8	ND	0.2	1	--
Picloram	ug/L	2	ND	1	48	ND	1	3	ND	1	--	--	--	8	ND	1	500	--
Propachlor	ug/L	2	ND	0.5	39	ND	0.5	3	ND	0.5	--	--	--	--	--	--	--	--
Propoxur	ug/L	2	ND	0.5	41	ND	0.5	2	ND	0.5	--	--	--	--	--	--	--	--
Simazine	ug/L	2	ND	1	48	ND	1	5	ND	1	--	--	--	9	ND	1	4	--
Terbacil	ug/L	--	--	--	2	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
Terbuthylazine	ug/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	2	ND	0.1	--	--
Thiobencarb	ug/L	2	ND	1	50	ND	1	4	ND	1	--	--	--	8	ND	1	70	1
Toxaphene	ug/L	2	ND	1	47	ND	1	3	ND	1	--	--	--	11	ND	1	3	--

Notes:
Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).
Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.
1. ug/L = micrograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. ND= not detected above laboratory reporting limit in any samples.
6. RL = Laboratory reporting limit. In the case of multiple reporting limits, the highest limit is shown. NA is shown if the reporting limit is not available.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA

Table C-6 Summary of 2019 Pesticide Detections

Notes:
No pesticides were detected at concentrations above respective method reporting limits.
Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).
Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. -- = no value available.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <0.1) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

Table C-7 Summary of 2019 Radioactive Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Llagas Subbasin								Maximum Contaminant Levels	
		Shallow Zone[2]				Principal Zone[3]								Shallow Zone				Principal Zone					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Gross Alpha	pCi/L	--	--	--	--	17	<3	0.81	6.5	--	--	--	--	--	--	--	--	9	<3	1.5	3.25	15	--
Gross Beta	pCi/L	--	--	--	--	10	<4	<4	<4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226	pCi/L	--	--	--	--	4	0.06	0.06	0.06	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 228	pCi/L	--	--	--	--	5	0.45	0.45	0.45	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Strontium-90	pCi/L	--	--	--	--	1	0.14	0.14	0.14	--	--	--	--	--	--	--	--	--	--	--	--	8	--
Tritium	pCi/L	--	--	--	--	1	<1,000	<1,000	<1,000	--	--	--	--	--	--	--	--	--	--	--	--	20,000	--
Uranium	pCi/L	--	--	--	--	4	<1	<1	<1	--	--	--	--	--	--	--	--	--	--	--	--	20	--

Notes:

Table includes data for wells monitored by Valley Water (annual monitoring network wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. pCi/L = picocuries per liter; mrem/yr = millirem per year.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

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APPENDIX D

2019 Recharge Water Quality Results

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Table D-1 Summary of 2019 Recharge Water Quality Indicator Data

Parameter	Units	Recharge System											
		Coyote				Los Gatos				Westside			
		n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Water Quality Indicators													
Bicarbonate Alkalinity (as CaCO3)	mg/L	12	148	213	259	12	112	149	154	6	233	250	265
Oxidation Reduction Potential (ORP)	mV	18	33	143	249	18	52	133	213	9	149	175	190
pH, Field	pH Units	18	7.52	7.79	8.19	18	7.4	8.0	8.6	9	7.0	7.7	7.9
Source Temperature	C	18	18.5	22.7	25.2	18	18	23	27	9	14	17	72
Specific Conductance, Field	uS/cm	18	277	533	692	18	273	316	441	9	431	486	517
Turbidity, Field	NTU	18	2.74	11.2	29.9	18	2.3	3.6	12	9	29	47	67
Total Alkalinity (as CaCO3)	mg/L	18	121	176	213	18	106	122	129	9	191	208	217
Major and Minor Ions													
Bicarbonate (as HCO3)	mg/L	6	150	212	249	6	101	145	148	3	259	263	264
Boron	ug/L	12	82	113	135	12	<50	58	79	6	100	109	124
Bromide	mg/L	18	<0.1	<0.1	0.15	18	<0.1	<0.1	<0.1	9	<0.1	<0.1	<0.1
Calcium (Dissolved)	mg/L	18	31	48	54	18	21	34	38	9	62	65	68
Chloride	mg/L	18	14	33	49	18	9	11	34	9	15	18	21
Fluoride (natural source)	mg/L	18	0.11	0.15	0.26	18	0.11	0.16	0.25	9	0.14	0.15	0.19
Magnesium (Dissolved)	mg/L	18	14	26	39	18	12	14	16	9	19	21	23
Potassium (Dissolved)	mg/L	18	1.4	1.7	2.1	18	1.2	1.9	2.2	9	1.4	1.5	1.5
Silica	mg/L	12	11	15	18	12	8	14	16	6	18	19	19
Sodium (Dissolved)	mg/L	18	17	26	37	18	12	17	28	9	16	18	20
Sulfate	mg/L	18	31	51.0	54	18	31	32	37	9	34	36	39
Total Dissolved Solids (TDS)	mg/L	18	106	289	390	18	184	202	240	9	296	322	340

Notes:
1. n = number of samples
2. mg/L = milligrams per liter;ug/L = micrograms per liter; mV = millivolts; C = Celsisus; uS/cm = microsiemens per centimeter; NTU = Nephelometric Turbidity Units;

Table D-2 Summary of 2019 Recharge Water Quality Trace Metals Data

Parameter	Units	Recharge System											
		Coyote				Los Gatos				Westside			
		n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Aluminum (Dissolved)	ug/L	18	<20	<20	28	18	<20	<20	24	9	<20	<20	<20
Antimony (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Arsenic (Dissolved)	ug/L	18	<2	<2	3	18	<2	<2	3	9	<2	<2	2
Barium (Dissolved)	ug/L	18	57	83	110	18	34	42	52	9	91	104	110
Beryllium (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Cadmium (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Chromium (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Cobalt	ug/L	12	<1	<1	<1	12	<1	<1	<1	6	<1	<1	<1
Copper (Dissolved)	ug/L	18	1	1.3	1.9	18	<1	1.5	3.2	9	<1	<1	1.3
Iron (Dissolved)	ug/L	18	<20	<20	<20	18	<20	<20	26	9	<20	<20	<20
Lead (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Lithium (Dissolved)	ug/L	18	6.7	9.7	11	18	<5	5.3	6.1	9	6.3	6.7	7.0
Manganese (Dissolved)	ug/L	18	<1	3.8	17	18	<1	1.5	5.7	9	<1	3.8	33
Mercury (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Molybdenum (Dissolved)	ug/L	18	<1	<1	1.7	18	<1	1.3	1.5	9	1.6	1.8	2.2
Nickel (Dissolved)	ug/L	18	1.8	2.1	2.7	18	<1	<1	1.2	9	<1	1.1	1.3
Selenium (Dissolved)	ug/L	18	<5	<5	<5	18	<5	<5	<5	9	<5	<5	<5
Silver (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Thallium (Dissolved)	ug/L	18	<1	<1	<1	18	<1	<1	<1	9	<1	<1	<1
Vanadium (Dissolved)	ug/L	18	1.5	2.0	3.2	18	1.6	1.9	7.2	9	2.1	2.2	2.3
Zinc (Dissolved)	ug/L	18	<10	<10	<10	18	<10	<10	<10	9	<10	<10	<10

Notes:

1. n = number of samples
2. ug/L = micrograms per liter

Table C-3 Summary of 2019 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Bromochloromethane	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Bromodichloroacetic Acid (BDCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Bromodichloromethane (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	ND	1	--	--
Bromoform (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	**D**	1	--	
Bromomethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Carbon Disulfide	ug/L	1	ND	0.5	24	ND	0.5	1	ND	0.5	--	--	--	--	--	--	--	--
Carbon Tetrachloride	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	0.5	--
Chloroethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Chloroform (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	**D**	0.5	20	ND	1	--	--
Chloromethane	ug/L	13	ND	0.5	50	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
cis-1,2-Dichloroethene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	6	--
Di(2-Ethylhexyl) Adipate	ug/L	2	ND	5	45	ND	5	4	ND	5	--	--	--	8	ND	5	400	--
Di(2-Ethylhexyl) Phthalate	ug/L	2	ND	3	45	ND	3	4	ND	3	--	--	--	8	ND	3	4	--
Dibromoacetic Acid (DBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Dibromochloroacetic Acid (CDBAA)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	1	ND	2	--	--
Dibromochloromethane (THM)	ug/L	13	ND	1	63	**D**	1	7	ND	1	18	ND	0.5	20	ND	1	--	--
Dibromochloropropane (DBCP)	ug/L	2	ND	0.01	46	ND	0.01	3	ND	0.01	--	--	--	12	ND	0.01	0.2	--
Dibromomethane	ug/L	13	ND	0.5	51	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	2	ND	1	--	--
Dichlorodifluoromethane (Freon 12)	ug/L	13	ND	0.5	63	**D**	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Dichloromethane	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	5	--
Diisopropyl Ether	ug/L	13	ND	3	51	ND	3	7	ND	3	18	ND	2	20	ND	3	--	--
Ethylbenzene	ug/L	13	ND	0.5	114	ND	0.5	8	ND	0.5	18	ND	0.5	57	ND	0.5	300	--
Ethylene Dibromide (EDB)	ug/L	2	ND	0.02	--	--	--	3	ND	0.02	--	--	--	12	ND	0.02	0.05	--
Ethylenediamine Tetra-Acetic Acid	mg/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	2	ND	0.1	--	--
Ethyl-Tert-Butyl Ether	ug/L	13	ND	3	63	ND	3	7	ND	3	18	ND	2	20	ND	3	--	--
Hexachlorobutadiene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Isopropylbenzene	ug/L	13	ND	0.5	63	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
m,p-Xylene	ug/L	13	ND	0.5	69	ND	0.5	7	ND	0.5	18	ND	0.5	20	ND	0.5	--	--
Methyl Ethyl Ketone (MEK, Butanone)	ug/L	1	ND	0.5	28	ND	5	2	ND	5	--	--	--	1	ND	5	--	--
Methyl Isobutyl Ketone	ug/L	1	ND	0.5	41	ND	5	2	ND	5	--	--	--	1	ND	5	--	--
Methyl Tert-Butyl Ether (MTBE)	ug/L	13	ND	3	119	ND	3	8	ND	3	18	ND	2	57	ND	3	13	5

Table D-3 Summary of 2019 Recharge Water Quality Volatile Organic Compounds Data

Parameter	Units	Recharge System							
		Coyote				Westside			
		n	Min	Median	Max	n	Min	Median	Max
4-Chlorotoluene	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Benzene	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Benzo (a) Pyrene	ug/L	9	<0.1	<0.1	<0.1	6	<0.1	<0.1	<0.1
Bromobenzene	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Carbon Tetrachloride	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Chloroethane	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Chloromethane	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Dichlorodifluoromethane (Freon 12)	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5
Dichloromethane	ug/L	9	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5

Notes:

1. n = number of samples
2. Volatile Organic Compounds were not measure in the Los Gatos Watershed
3. ug/L = micrograms per liter

Table D-4 Summary of 2019 Recharge Water Quality Pesticide Data

Parameter	Units	Recharge System											
		Coyote				Los Gatos				Westside			
		n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max
Alachlor	ug/L	9	<0.25	<0.25	<0.25	3	<0.25	<0.25	<0.25	6	<0.25	<0.25	<0.25
Atrazine	ug/L	9	<0.25	<0.25	<0.25	3	<0.25	<0.25	<0.25	6	<0.25	<0.25	<0.25
cis-1,3-Dichloropropene	ug/L	9	<0.5	<0.5	<0.5	0	N/A	N/A	N/A	3	<0.5	<0.5	<0.5
gamma-BHC (lindane)	ug/L	9	<0.2	<0.2	<0.2	3	<0.2	<0.2	<0.2	6	<0.2	<0.2	<0.2
Hexachlorobenzene	ug/L	9	<0.25	<0.25	<0.25	3	<0.25	<0.25	<0.25	6	<0.25	<0.25	<0.25
Hexachlorocyclopentadiene	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5	6	<0.5	<0.5	<0.5
Methoxychlor	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5	6	<0.5	<0.5	<0.5
Molinate	ug/L	9	<0.5	<0.5	<0.5	3	<0.5	<0.5	<0.5	6	<0.5	<0.5	<0.5
Simazine	ug/L	9	<0.25	<0.25	<0.25	3	<0.25	<0.25	<0.25	6	<0.25	<0.25	<0.25
Thiobencarb	ug/L	9	<0.25	<0.25	<0.25	3	<0.25	<0.25	<0.25	6	<0.25	<0.25	<0.25
trans-1,3,Dichloropropene	ug/L	9	<0.5	<0.5	<0.5	0	N/A	N/A	N/A	3	<0.5	<0.5	<0.5

Notes:
1. n = number of samples
2. N/A = not measured
3. ug/L = micrograms per liter

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APPENDIX E

2019 Water Quality Evaluation at Recycled Water Irrigation Sites

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Table E-1 Summary of 2019 Santa Clara Subbasin Recycled Water Data

Parameter	Units	Santa Clara Subbasin, Santa Clara Plain				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Major and Minor Ions							
Bicarbonate Alkalinity (as CaCO3)	mg/L	10	160	330	820	--	--
Calcium	mg/L	10	42	90	370	--	--
Chloride	mg/L	10	23	124	390	--	250
Magnesium	mg/L	10	15	65	160	--	--
Potassium	mg/L	10	<1.0	1.6	5.9	--	--
Sodium	mg/L	10	35	57	280	--	--
Sulfate	mg/L	10	38	72	920	--	250
Total Dissolved Solids (TDS)	mg/L	10	280	645	2,100	--	500
Nutrients							
Nitrate (as N)	mg/L	10	<0.05	4.57	8.80	10	--
Trace Elements							
Boron	mg/L	10	<0.2	<0.2	0.85	--	--

Notes:

1. Table includes data for wells near areas irrigated with water from South Bay Water Recycling (SBWR)
2. n = number of results
3. MCL = Maximum Contaminant Level as specified in Title 22 of the California Code of Regulations
4. SMCL = Secondary Maximum Contaminant Level or aesthetic-based standard per DDW or US EPA
5. mg/L = milligrams per liter, ug/L = micrograms per liter; ng/L = nanograms per liter

Table E-2 Summary of 2019 Llagas Subbasin Recycled Water Irrigation Inorganic Data

Parameter	Units	Llagas Subbasin				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Major and Minor Ions							
Bromate	ug/L	20	<0.25	<0.25	0.29	10	--
Bromide	mg/L	20	0.05	0.05	0.66	--	--
Calcium	mg/L	20	7.3	47	97	--	--
Calcium (as CaCO3)	mg/L	20	18.3	117	242	--	--
Chloride	mg/L	20	<5	27	212	--	250
Cyanide	mg/L	20	<0.025	<0.025	<0.025	150	-
Fluoride (natural source)	mg/L	20	<0.1	<0.1	0.5	2	--
Magnesium	mg/L	20	2.9	25	66	--	--
Perchlorate	ug/L	20	<4	<4	<4	6	--
Potassium	mg/L	20	<0.5	1.1	2.4	--	--
Silica	mg/L	20	8.5	25	35	--	--
Sodium	mg/L	20	3.5	25	158	--	--
Sulfate	mg/L	20	2.8	41	118	--	250
Total Dissolved Solids (TDS)	mg/L	20	77	313	820	--	500
Nutrients							
Nitrate (as N)	mg/L	20	<0.05	1.9	28	10	--
Orthophosphate (as P)	mg/L	18	<0.05	<0.05	0.13	--	--
Trace Elements							
Aluminum	ug/L	20	<20	37	220	1,000	200
Antimony	ug/L	20	<1	<1	<1	6	--
Arsenic	ug/L	20	<2	<2	2	10	--
Barium	ug/L	20	22	83	490	1,000	--
Beryllium	ug/L	20	<1	<1	<1	4	--
Boron	ug/L	20	<50	100	353	--	--
Cadmium	ug/L	20	<1	<1	<1	5	--
Chromium	ug/L	20	<1	<1	4.2	50	--
Cobalt	ug/L	20	<1	<1	3.9	--	--
Copper	ug/L	20	<1	2.1	6.3	1,300	1,000
Iron	ug/L	20	<20	<20	250	--	300
Lead	ug/L	20	<1	<1	3.9	--	--
Lithium	ug/L	20	<5	5.7	11	--	--
Manganese	ug/L	20	<1	1.0	1,330	--	50
Mercury	ug/L	20	<1	<1	<1	2	--
Molybdenum	ug/L	20	<1	<1	4.5	--	--

Table E-2 Summary of 2019 Llagas Subbasin Recycled Water Irrigation Inorganic Data

Parameter	Units	Llagas Subbasin				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Nickel	ug/L	20	<1	1.9	21	100	--
Selenium	ug/L	20	<5	<5	6	50	--
Silver	ug/L	20	<1	<1	<1	--	100
Thallium	ug/L	20	<1	<1	<1	2	--
Vanadium	ug/L	20	<1	1.2	4.6	--	--
Zinc	ug/L	20	<10	<10	<10	--	5,000

Notes:

1. Table includes data for wells near areas irrigated with water from South County Regional Wastewater Authority (SCRWA)
2. n = number of results
3. MCL = Maximum Contaminant Level as specified in Title 22 of the California Code of Regulations
4. SMCL = Secondary Maximum Contaminant Level or aesthetic-based standard per DDW or US EPA
5. mg/L = milligrams per liter, ug/L = micrograms per liter; ng/L = nanograms per liter

Table E-3 Summary of 2019 Llagas Subbasin Recycled Water Irrigation Organic Data

Parameter	Units	Llagas Subbasin				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Bromochloroacetic Acid (BCAA)	ug/L	20	<1	<1	<1	1,000	200
Bromochloromethane	ug/L	20	<0.5	<0.5	<0.5	6	--
Bromodichloroacetic Acid (BDCAA)	ug/L	20	<1	<1	<1	10	--
Bromodichloromethane (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Bromoform (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Bromomethane	ug/L	20	<0.5	<0.5	<0.5	--	--
Chlorodibromoacetic Acid (CDBAA)	ug/L	20	<2	<2	<2	--	--
Chloroform (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Dibromoacetic Acid (DBAA)	ug/L	20	<1	<1	<1	--	--
Dibromochloromethane (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Dibromomethane	ug/L	20	<0.5	<0.5	<0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	20	<1	<1	<1	--	--
Haloacetic Acids (HAA5)	ug/L	20	1	1	1	--	--
Monobromoacetic Acid (MBAA)	ug/L	20	<1	<1	<1	--	--
Monochloroacetic Acid (MCAA)	ug/L	20	<2	<2	<2	--	--
n-Nitrosodiethylamine (NDEA)	ng/L	20	<2	<2	<2	--	--
n-Nitrosodimethylamine (NDMA)	ng/L	20	<2	<2	5	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	20	<2	<2	<2	--	--
n-Nitrosodi-n-Propylamine (NDPA)	ng/L	20	<2	<2	<2	--	--
n-Nitrosomethylethylamine (NMEA)	ng/L	20	<2	<2	<2	--	--
n-Nitrosopyrrolidine (NPYR)	ng/L	20	<2	<2	<2	--	--
Perfluoro Butanoic Acid (PFBA)	ng/L	20	<10	<10	50	--	--
Perfluorooctyl Sulfonate (PFOS)	ng/L	20	<5	<5	96	--	--
Perfluorooctanoic Acid (PFOA)	ng/L	20	<5	<5	59	--	--
Tribromoacetic Acid (TBAA)	ug/L	20	<4	<4	<4	--	--
Trichloroacetic Acid (TCAA)	ug/L	20	<1	<1	<1	--	--

Notes:

1. Table includes data for wells near areas irrigated with water from South County Regional Wastewater Authority (SCRWA)
2. n = number of results
3. MCL = Maximum Contaminant Level as specified in Title 22 of the California Code of Regulations
4. SMCL = Secondary Maximum Contaminant Level or aesthetic-based standard per DDW or US EPA
5. mg/L = milligrams per liter, ug/L = micrograms per liter; ng/L = nanograms per liter

APPENDIX F

Water Quality 2019 Report for the Santa Clara and Llagas Subbasins

(Submitted to the California Department of Water Resources in April 2020)

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March 2020

Water Year 2019 Report for the Santa Clara and Llagas Subbasins

Valley Water

Santa Clara Valley Water District

Water Year 2019 Report for the Santa Clara and Llagas Subbasins

Prepared by:

Jason Gurdak, Ph.D., P.H.
Senior Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.
Unit Manager
Groundwater Management Unit

Garth Hall, P.E.
Deputy Operating Officer
Water Supply Division

Nina Hawk
Chief Operating Officer
Water Utility Enterprise

Norma J. Camacho
Chief Executive Officer

March 2020

Valley Water
Clean Water • Healthy Environment • Flood Protection

Contributors:

Chanie Abuye

Ardy Ghoreishi

Graphic Design:

Benjamin Apolo III

Emily Cheung

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TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY.....ES-i

CHAPTER 1 – INTRODUCTION 1

CHAPTER 2 – GROUNDWATER ELEVATION DATA..... 3

CHAPTER 3 – WATER SUPPLY AND USE 14

3.1 Groundwater Extraction 14
3.2 Surface Water Supply Used 16
3.3 Total Water Use 17
3.4 Change in Groundwater Storage 18

CHAPTER 4 – PLAN IMPLEMENTATION..... 30

Executive Summary

EXECUTIVE SUMMARY

The Santa Clara Valley Water District (Valley Water) is the Groundwater Sustainability Agency for the Santa Clara and Llagas subbasins (Basins 2-9.02 and 3-3.01, respectively) in Santa Clara County, which are sustainably managed due to the comprehensive activities described in Valley Water's 2016 Groundwater Management Plan (Plan).[1] This Water Year 2019 Report for the Santa Clara and Llagas Subbasins provides information on groundwater conditions and management as required by the Sustainable Groundwater Management Act (SGMA).[2]

Having previously fully recovered to pre-drought conditions, groundwater elevation and storage remained in healthy condition through Water Year (WY) 2019.[3] Total groundwater pumping was 109,600 acre-feet (AF)[4], providing 37% of the water used by county residents and businesses. WY 2019 was a wet year with adequate surface water supplies were available to support a full managed recharge program with 81,400 AF of local and imported surface water used for groundwater replenishment. Treated water delivered by Valley Water (103,000 AF) and recycled water use (17,100 AF) also provided in-lieu recharge, and countywide water conservation programs reduced water demands by more than 70,000 AF. This comprehensive recharge continues to support a balanced long-term water budget. Inflows exceeded outflows in the Santa Clara and Llagas subbasins, resulting in a net increase in storage of 11,400 and 6,600 AF, respectively.

Valley Water continues to implement the comprehensive activities described in the Plan, and to address the Plan recommendations (as further described in Chapter 4):

- Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.
- Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.
- Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.
- Maintain adequate monitoring programs and modeling tools.
- Continue and enhance groundwater management partnerships with water retailers and land use agencies.
- Evaluate the potential new authorities provided by SGMA.

Valley Water will continue to sustainably manage the Santa Clara and Llagas subbasins as a central part of our mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. Implementation of the Plan helps ensure continued sustainability in accordance with SGMA, the Santa Clara Valley Water District Act, and Valley Water Board policy to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion."

---

[1] This Plan was submitted to the Department of Water Resources as an Alternative to a Groundwater Sustainability Plan. Per state requirements, an annual report must be submitted by April 1 of each year following Valley Water adoption of the Plan.
[2] A comprehensive calendar-year based Annual Groundwater Report with detailed information on groundwater levels, storage, land subsidence and groundwater quality conditions is available at: https://www.valleywater.org/groundwater.
[3] October 1, 2018 through September 30, 2019
[4] All values presented in this report are based on best available data (measured and/or estimated) and may be refined as additional data becomes available.

CHAPTER 1 – INTRODUCTION

For 90 years, Valley Water has managed groundwater in Santa Clara County under the Santa Clara Valley Water District Act.[5] In December 2016, Valley Water submitted its Board-adopted 2016 Groundwater Management Plan (Plan)[6] to the Department of Water Resources (DWR) as an Alternative to a Groundwater Sustainability Plan under SGMA. Valley Water's comprehensive groundwater management programs and investments described in the Plan have resulted in sustainable groundwater conditions for many decades and will ensure groundwater resources are sustainable into the future.

Under the California Code of Regulations Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 7, §356.2, each agency shall submit an annual report to DWR by April 1 of each year following adoption of the Plan. This report for Water Year (WY) 2019 is the third annual report submitted to DWR. It covers the Santa Clara Subbasin (DWR Basin 2-9.02) and the Llagas Subbasin (Basin 3-3.01), which are managed in their entirety by Valley Water. Figure 1 shows the location of the two groundwater subbasins.

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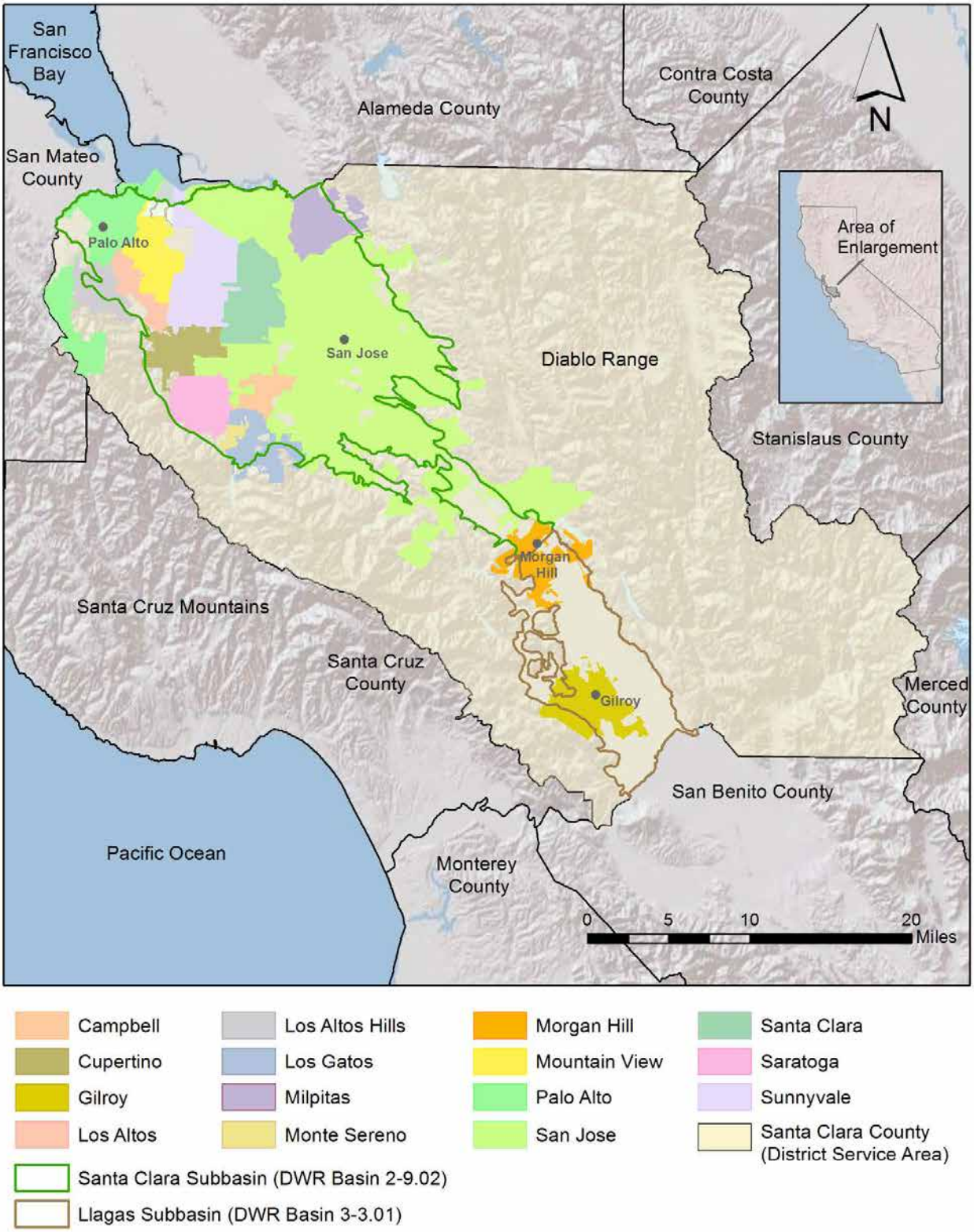
[5] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.
[6] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater

Figure 1. Santa Clara and Llagas Subbasin Location Map



CHAPTER 2 – GROUNDWATER ELEVATION DATA

Valley Water tracks groundwater elevations, groundwater quality, and land subsidence through a countywide groundwater monitoring program. In WY 2019, Valley Water collected monthly groundwater elevation readings at 157 wells in the Santa Clara Subbasin and 61 wells in the Llagas Subbasin. Furthermore, local water retailers shared groundwater elevation data at 114 wells. While this report provides a summary of groundwater elevations based on 11 regional wells, all available countywide groundwater elevation data are accessible through the Valley Water website.[7] Valley Water also regularly uploads groundwater elevation data for Valley Water-owned wells to the California Statewide Groundwater Elevation Monitoring (CASGEM) program database.

Groundwater elevation contour maps for the Santa Clara and Llagas subbasins and related measurement locations are presented in Figures 2 and 3 for Spring 2019 and Fall 2019, respectively.[8] These contours represent the principal aquifer within each subbasin because those aquifers support the vast majority of pumping. Seasonal high groundwater conditions typically occur in March or April, with seasonal lows in September or October. The spring and fall maps (Figures 2 and 3) were created using the water level readings measured closest to March 31, 2019 and September 30, 2019, respectively.

This report also presents groundwater elevation data from 11 regional wells in the Santa Clara and Llagas subbasins (Figure 4); these wells are spatially distributed within the two subbasins and various cities in the county. Hydrographs for these wells show the static water level trend over the period of record, which varies by well (Figure 5).

Due to good water supply conditions, robust managed recharge, and continued water use reduction by the community, groundwater elevations generally returned to pre-drought conditions in WY 2017. In fact, water levels in many wells approached or exceeded historical high levels. Groundwater levels remained sustainable in WY 2018 and 2019 (Figure 5) due to continued managed recharge and water use reduction. Groundwater elevations in WY 2019 were far above the historical minima and levels during the last major droughts of 1987-1992 and 2012-2016, with strong artesian pressures observed in the northern Santa Clara Subbasin. Groundwater elevations were also well above Valley Water thresholds established to minimize the risk of land subsidence in the Santa Clara Subbasin.[9]

[7] https://gis.valleywater.org/GroundwaterElevations
[8] Groundwater elevations in this report use the North American Vertical Datum of 1988 (NAVD 88).
[9] As described in the Plan, land subsidence was a significant issue historically in the central and northern Santa Clara Subbasin. See Valley Water's Annual Groundwater Report for Calendar Year 2018 for a detailed discussion of recent subsidence monitoring: https://www.valleywater.org/groundwater. Note, the CY 2019 report will be available in summer 2020.

Figure 2. Spring 2019 Groundwater Elevation Contours

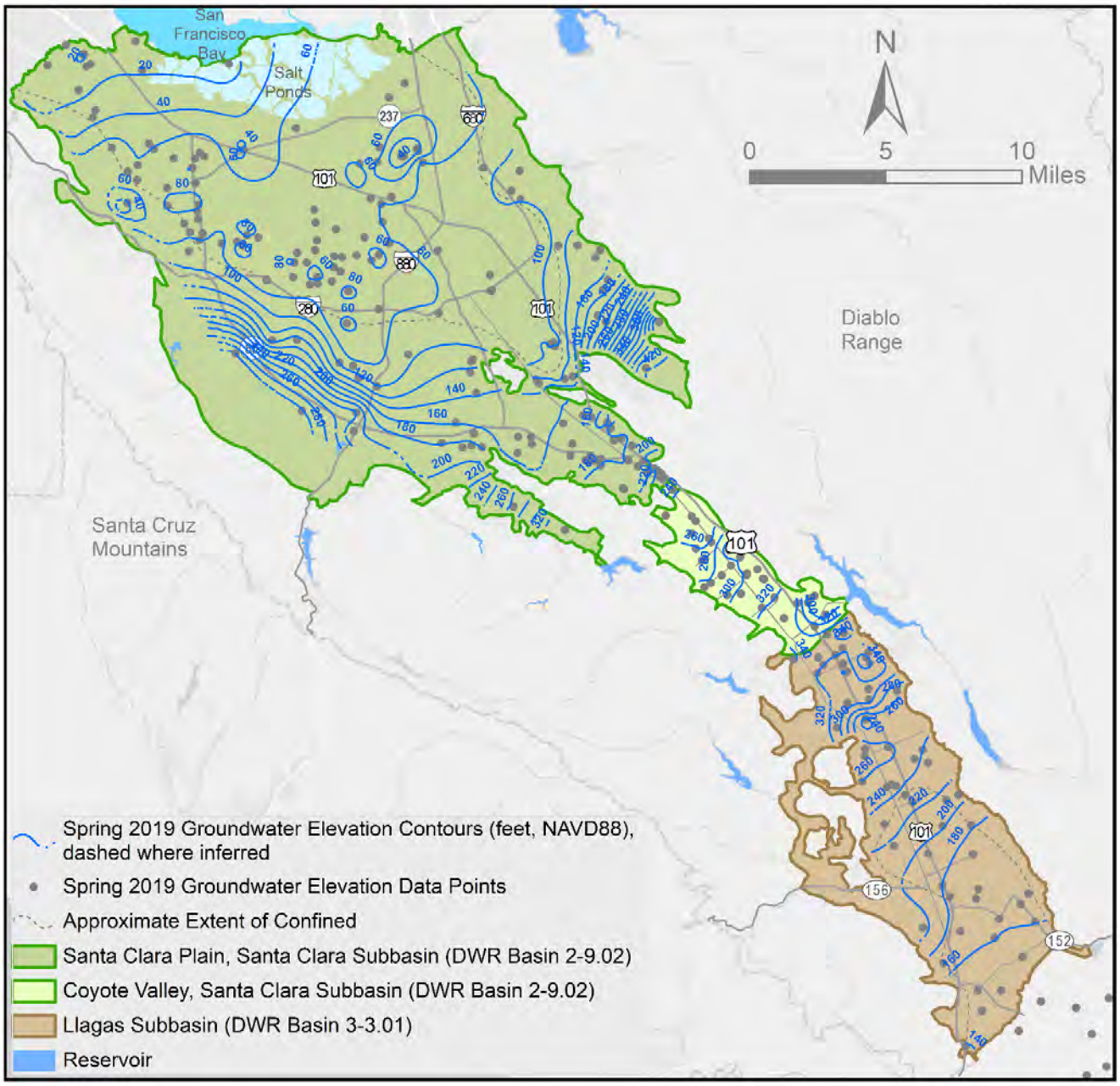


Figure 3. Fall 2019 Groundwater Elevation Contours

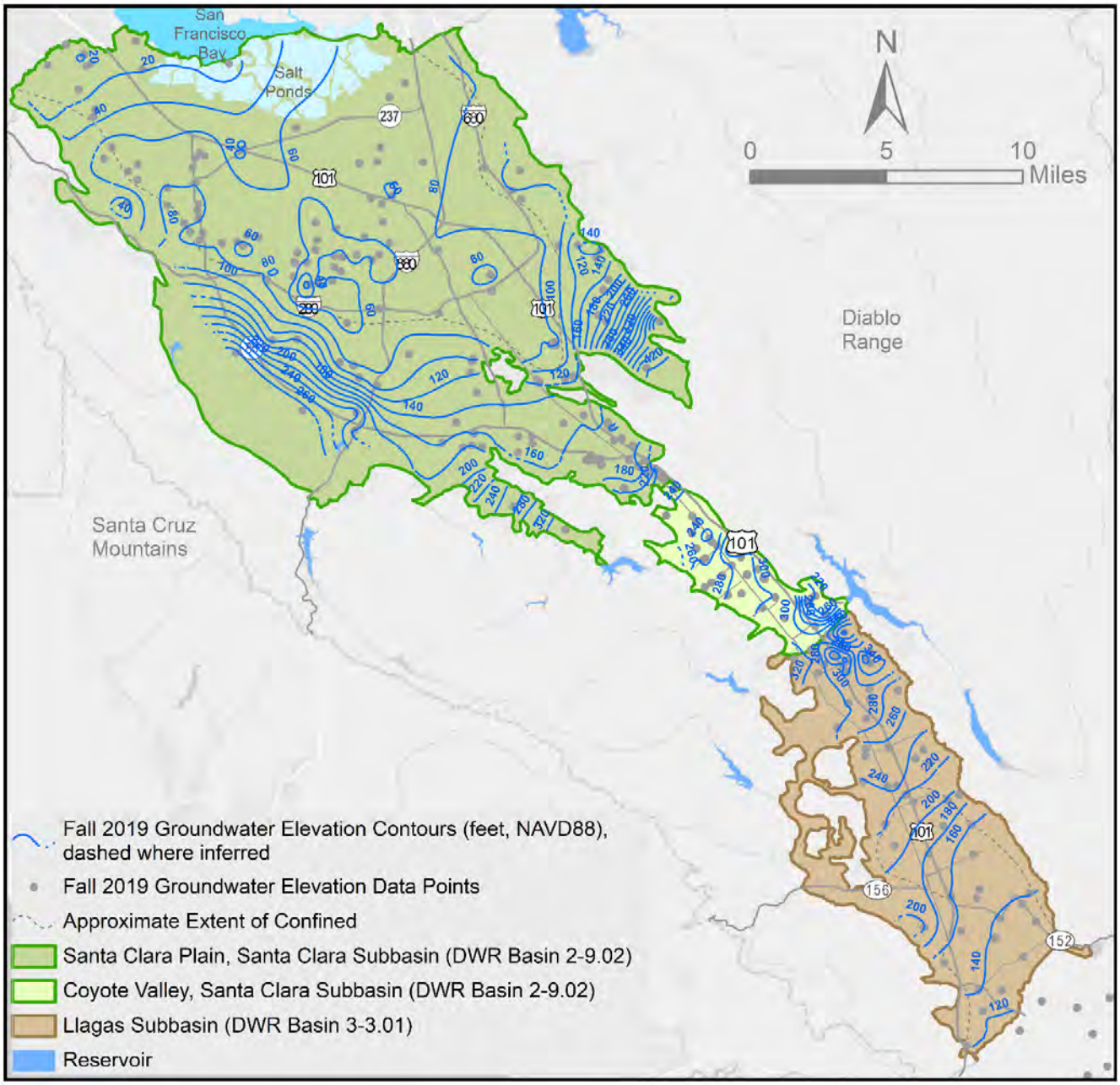


Figure 4. Regional Groundwater Elevation Monitoring Wells

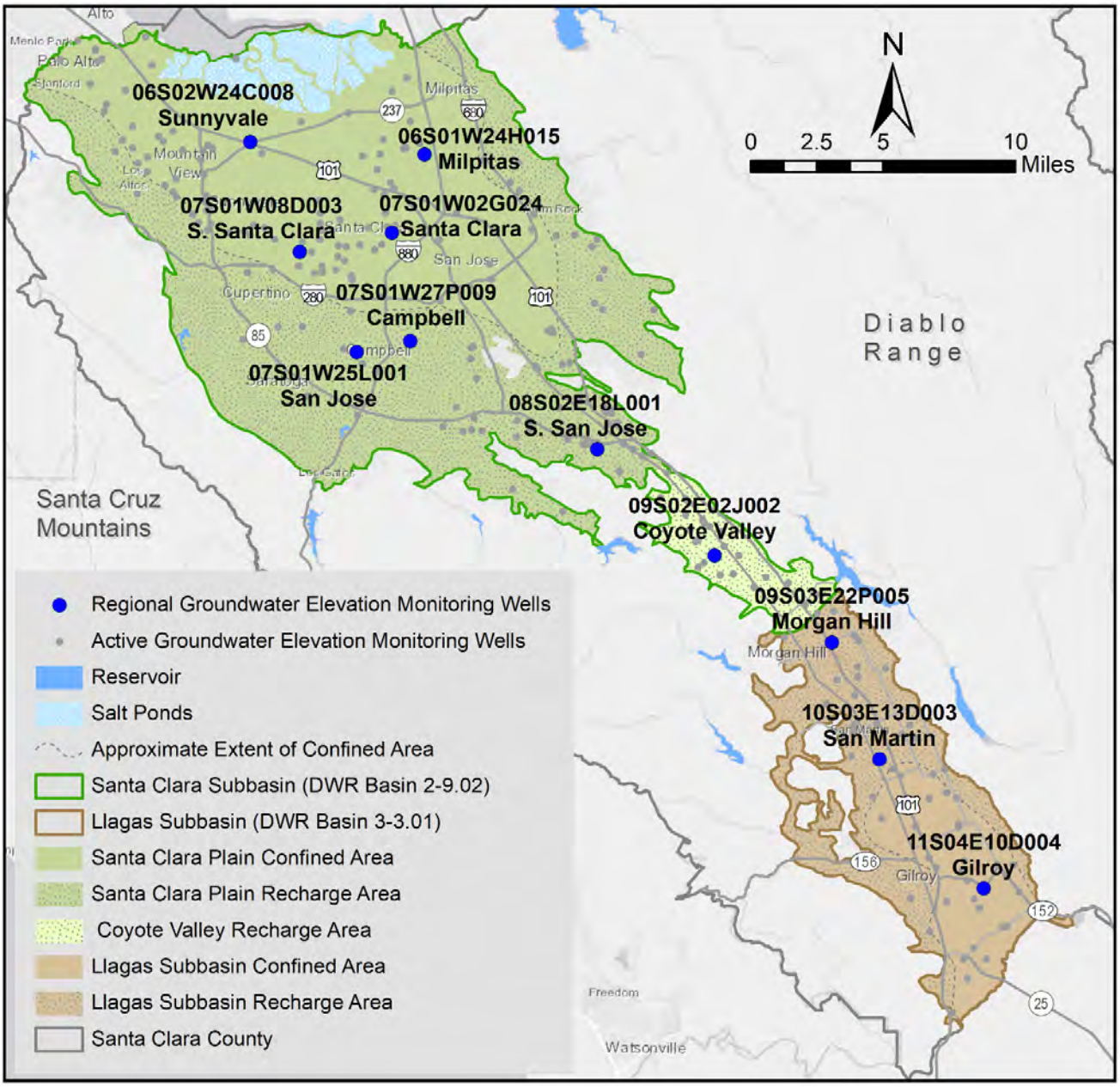
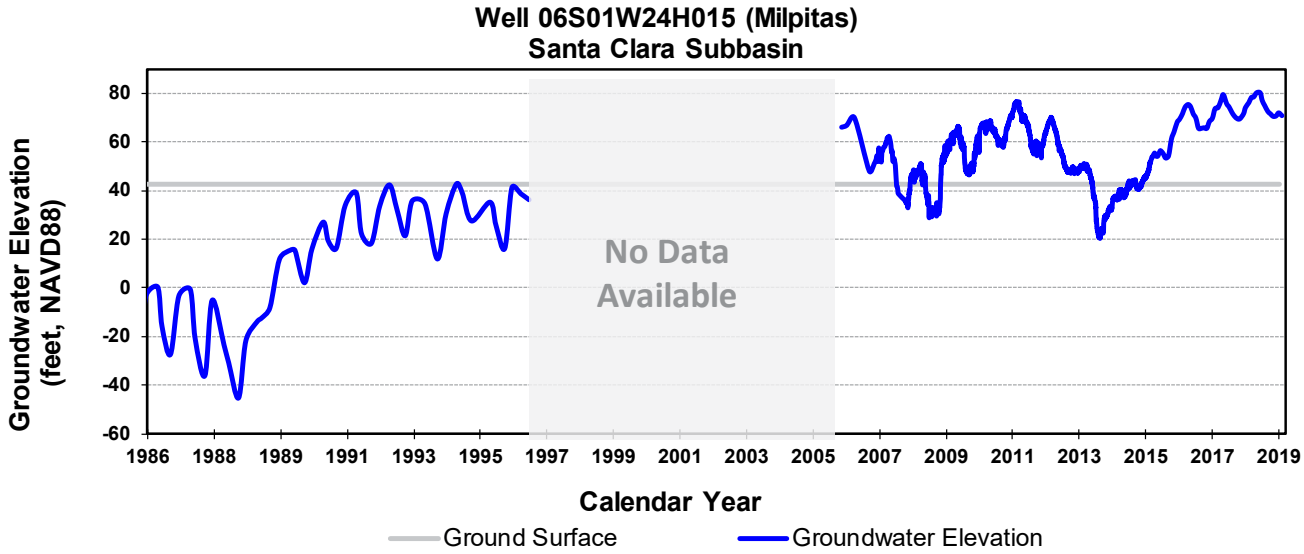
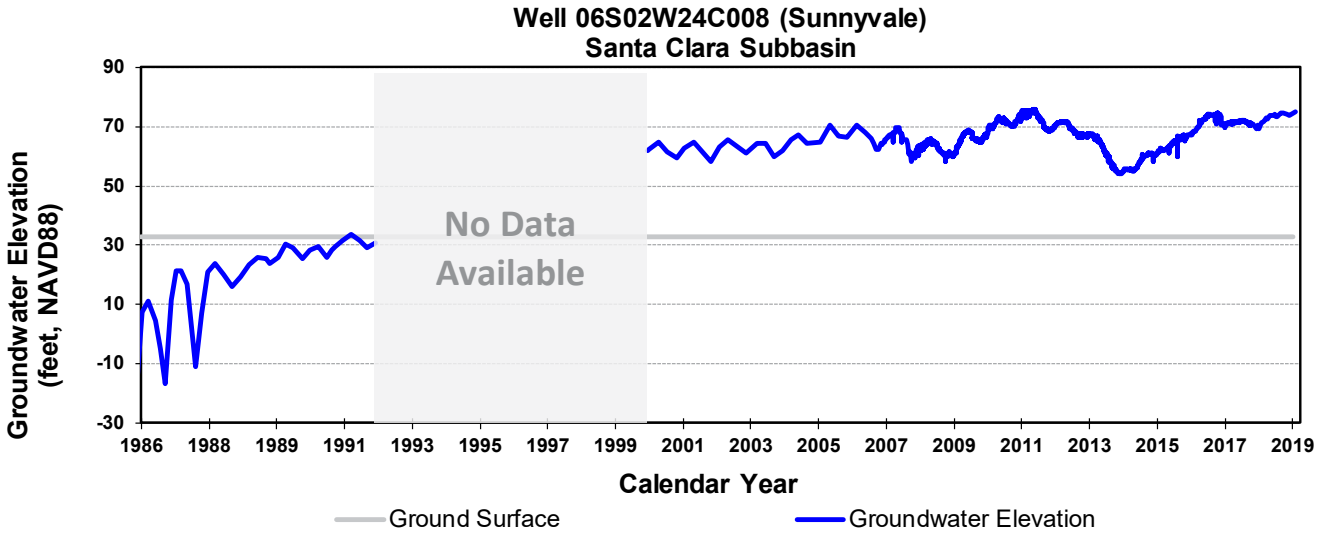


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells

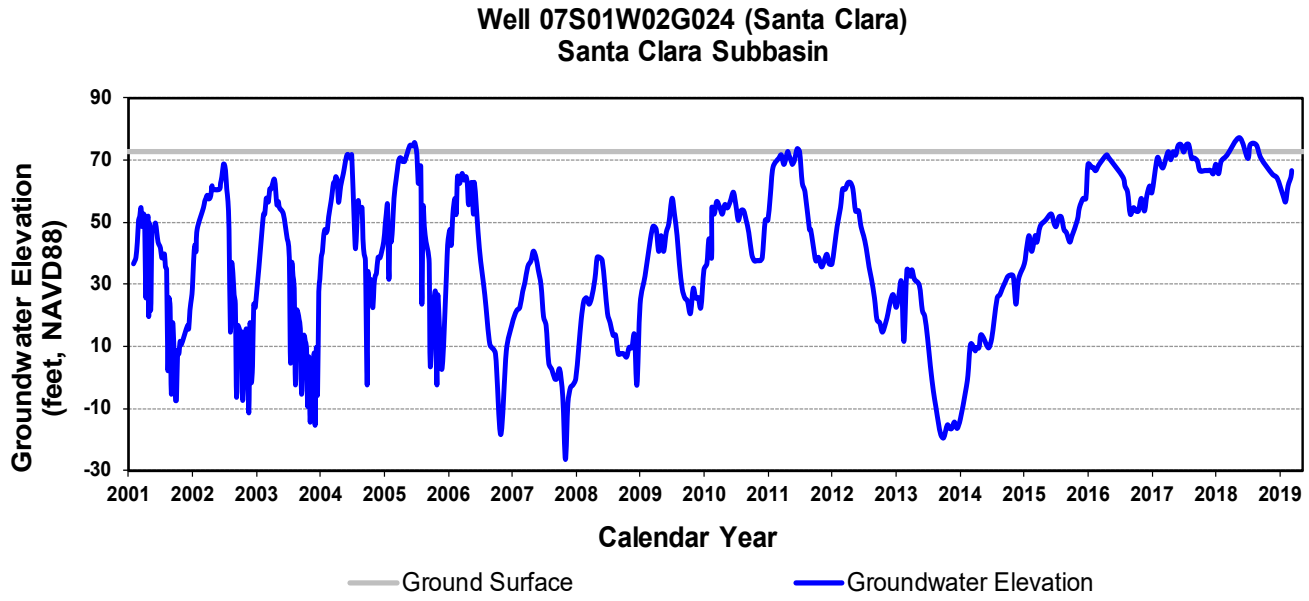


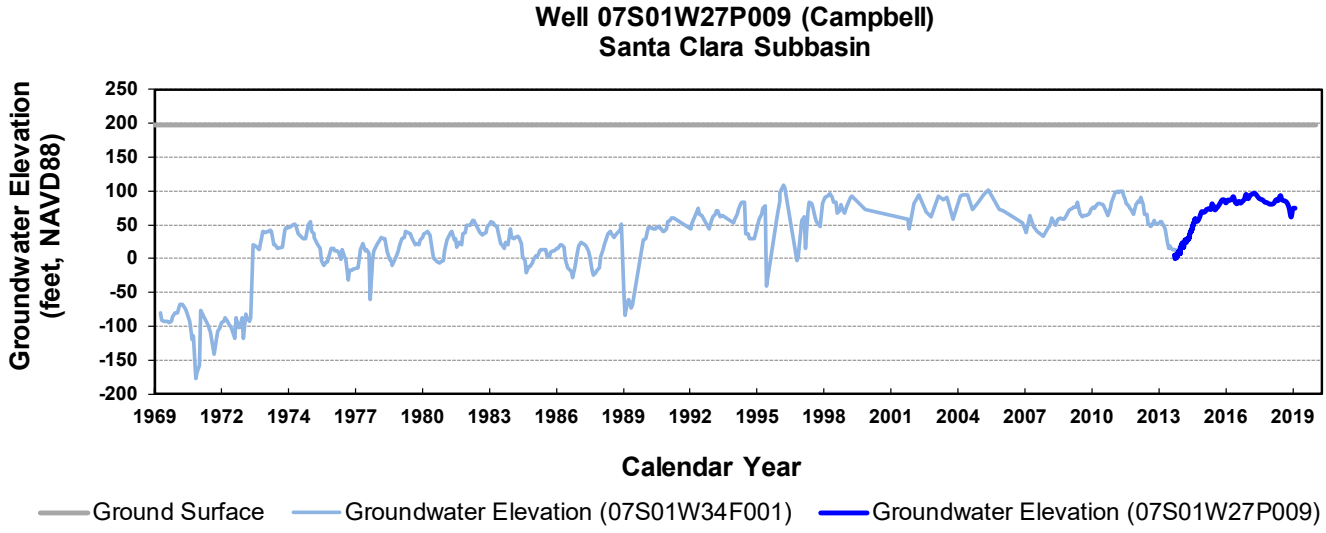
During period with no data available, well was observed to be artesian but there was no pressure gauge installed.



During period with no data available, well was observed to be artesian but there was no pressure gauge installed.

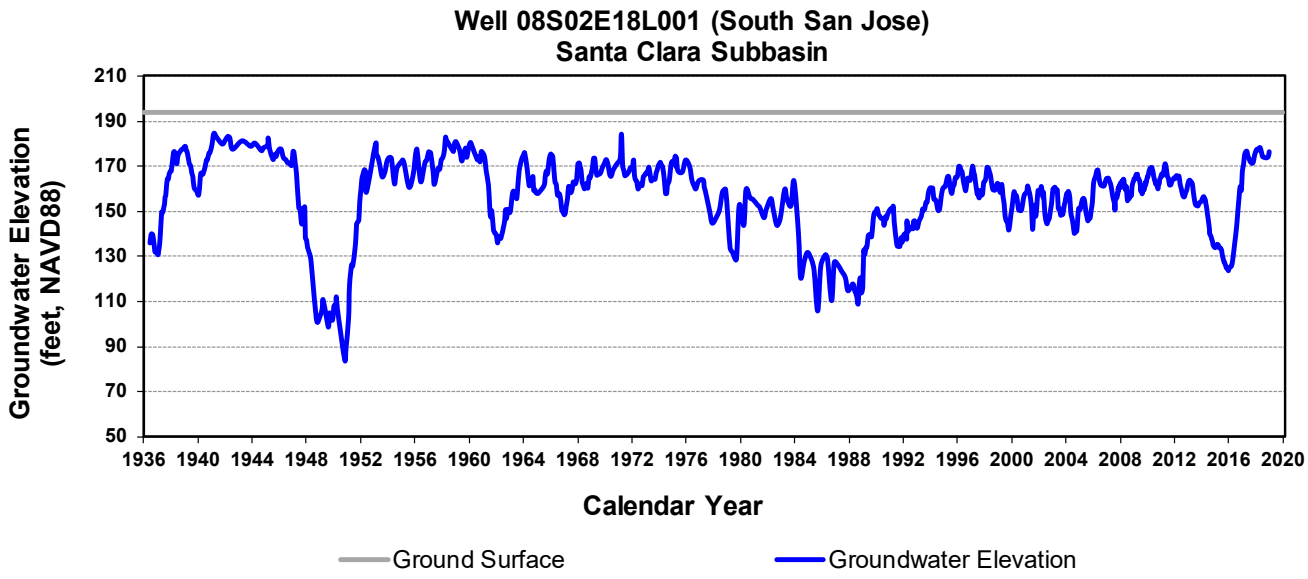
Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)





The Campbell well was replaced in August 2015 with a nearby well with similar water level history.

Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



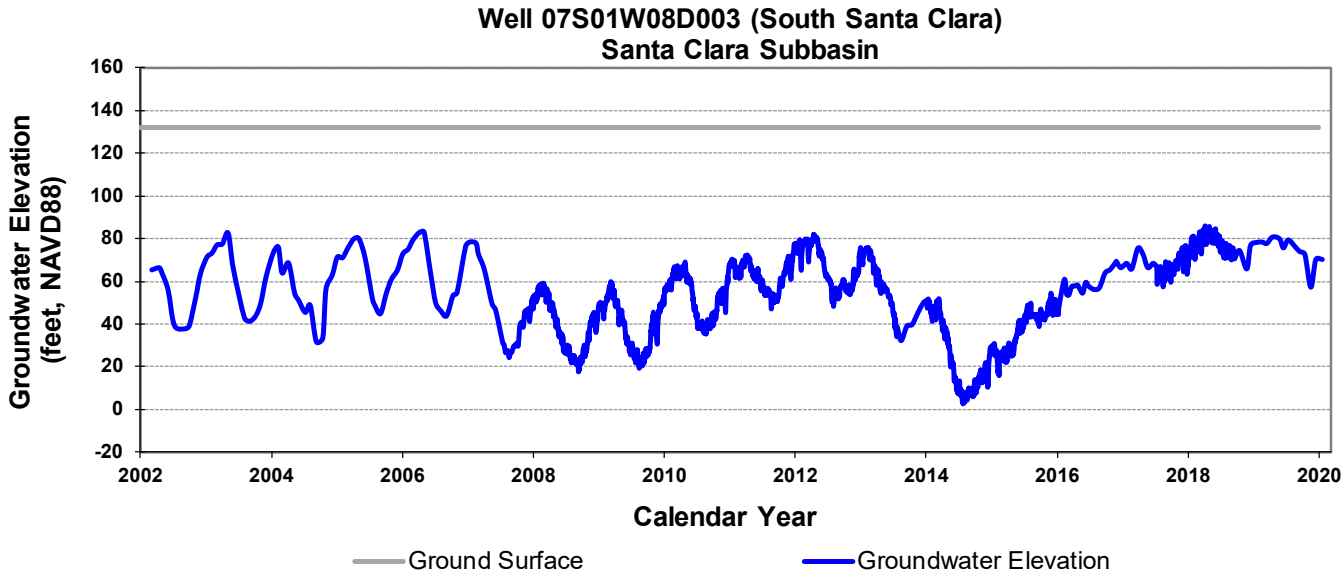
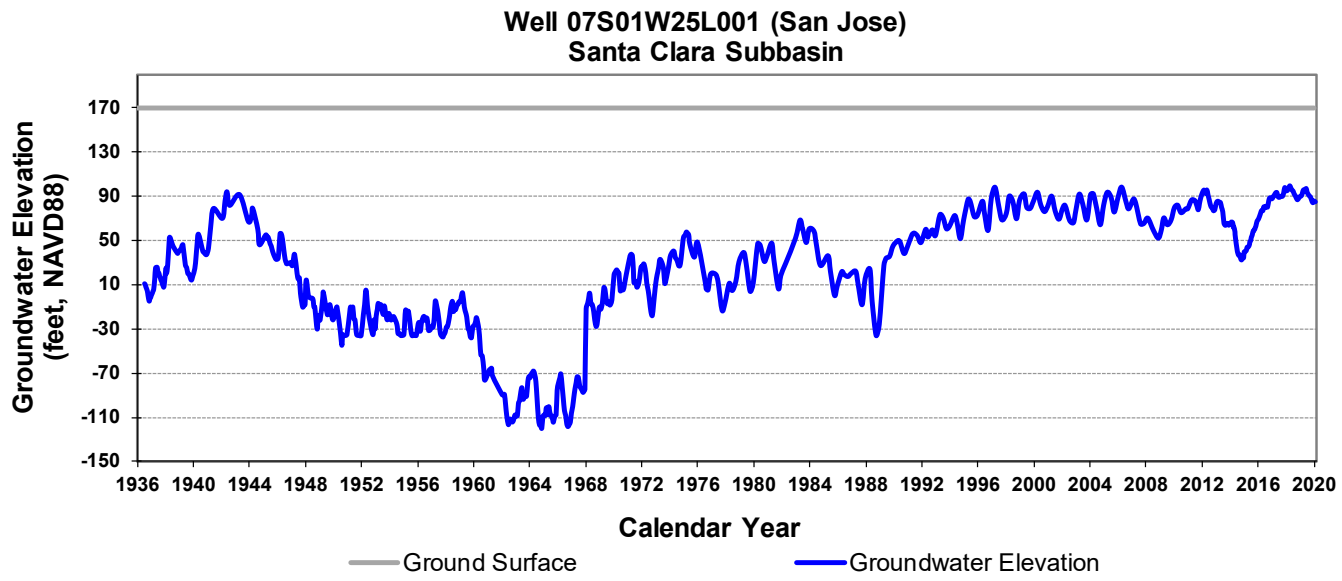


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



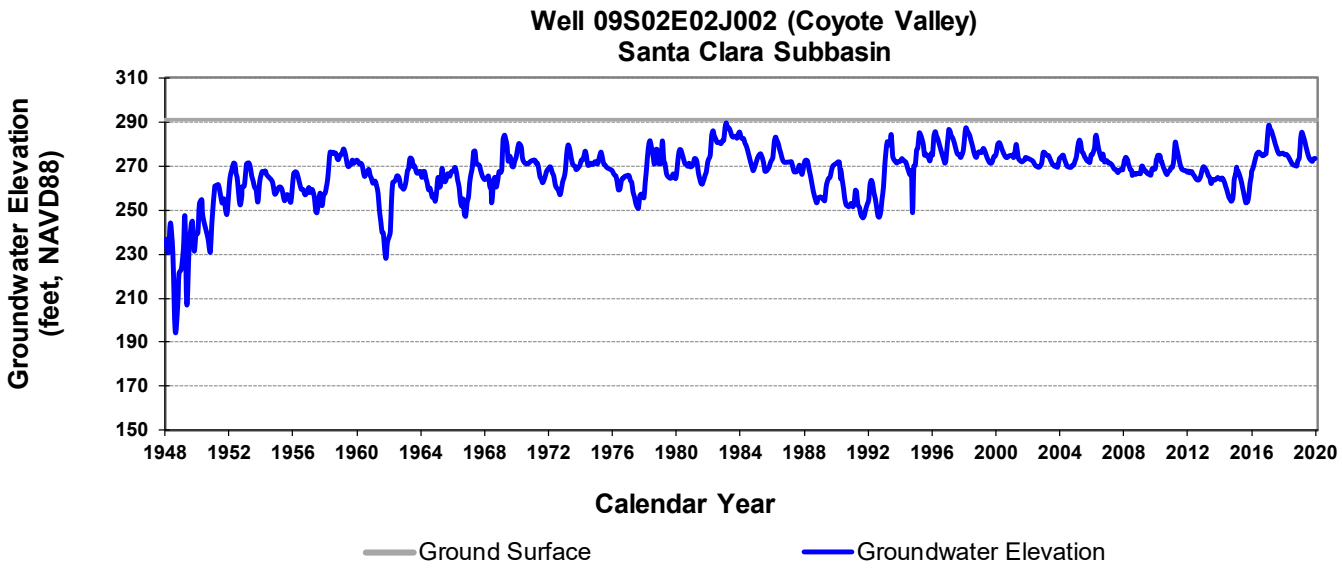
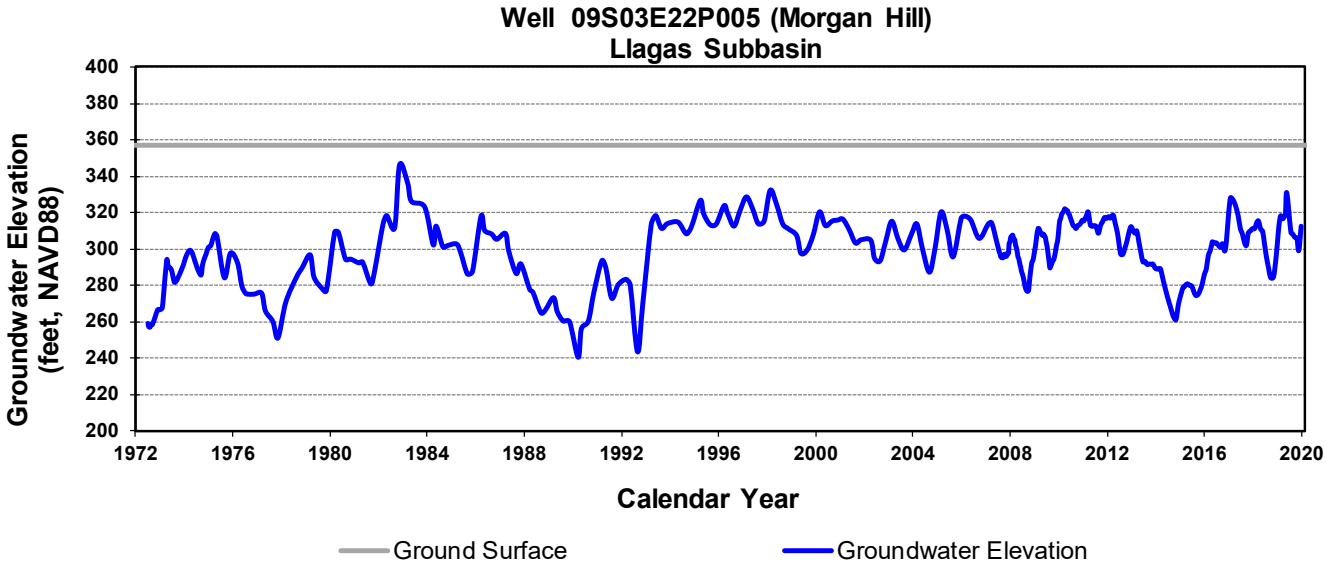


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



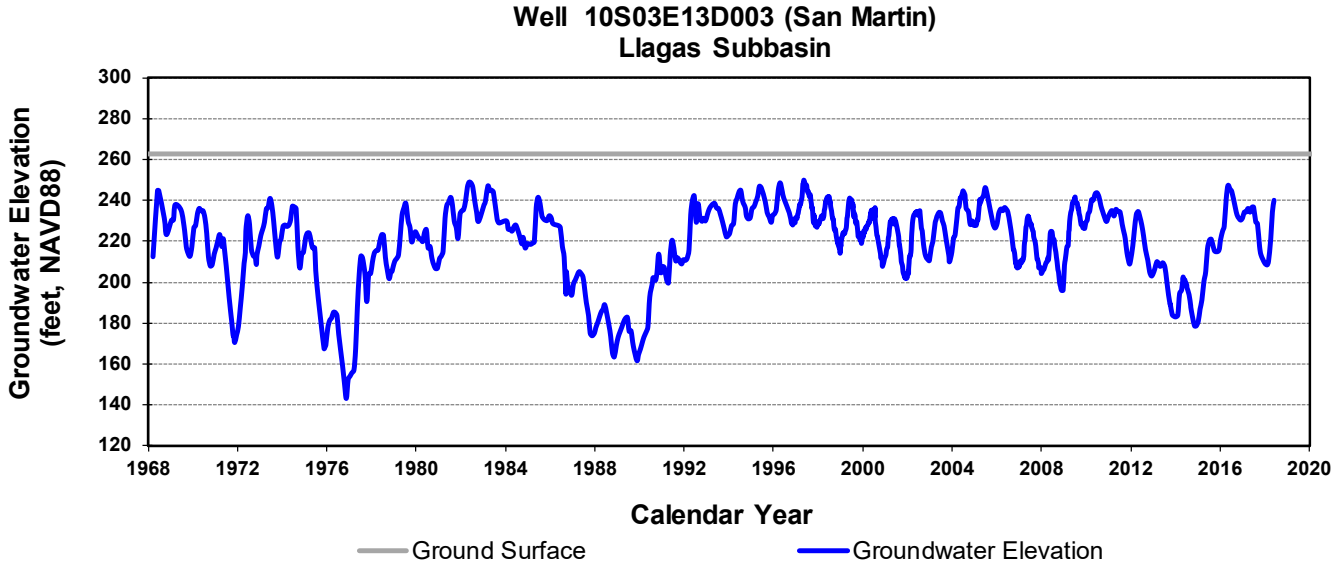
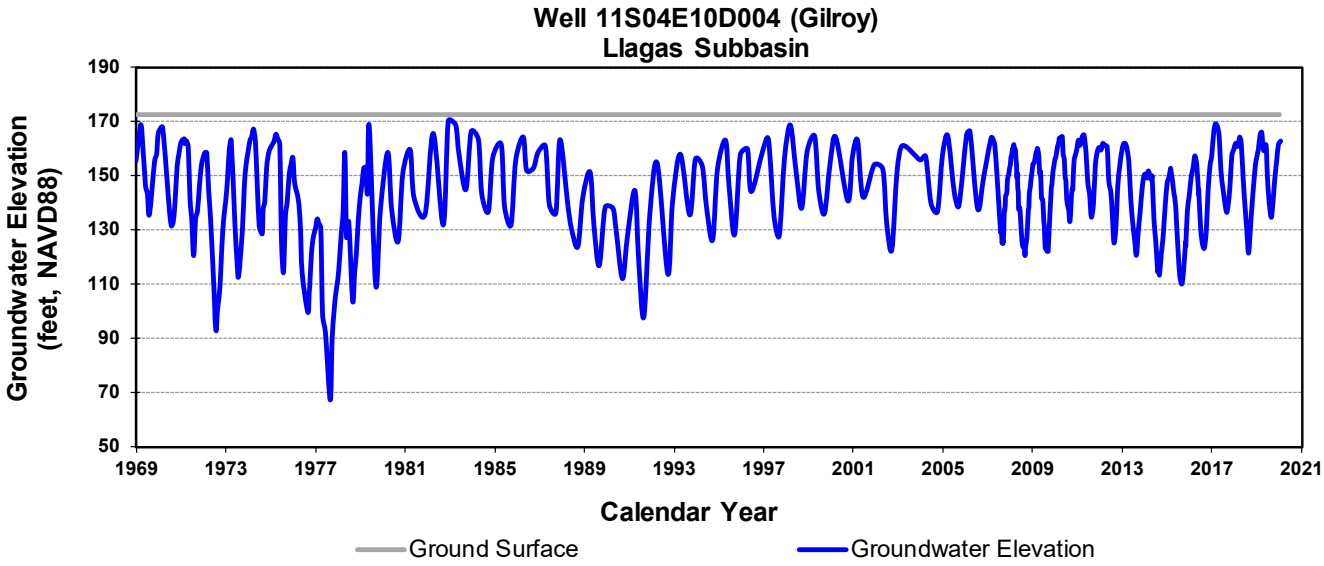


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



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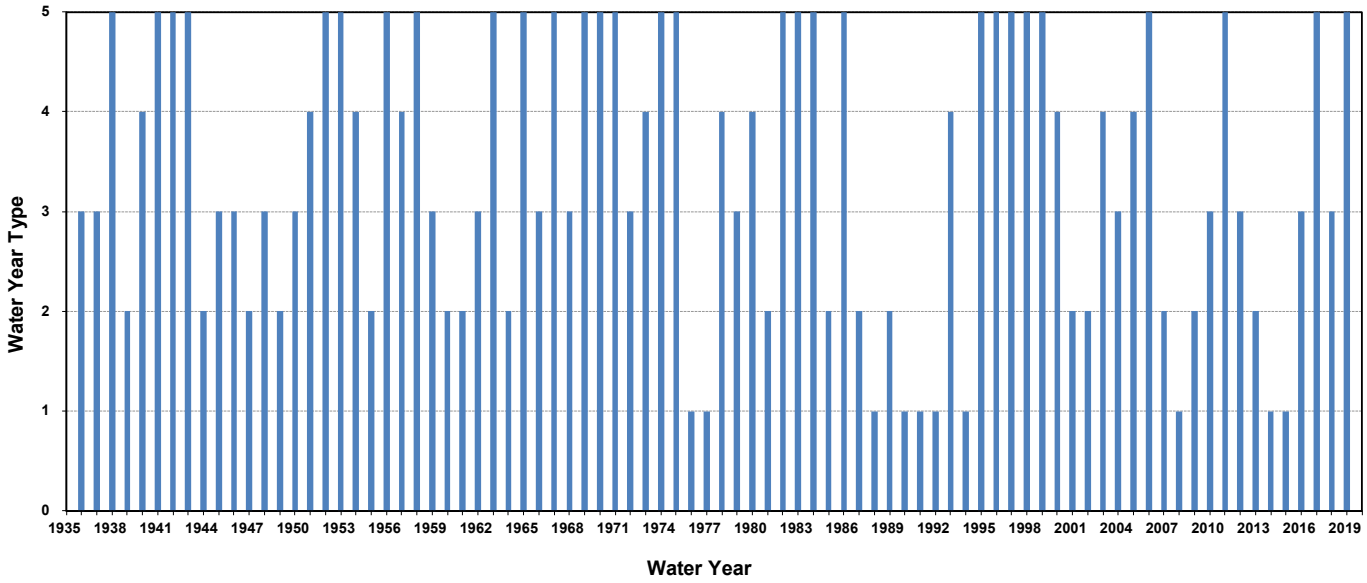
WY 2019 was a wet year based on the DWR Sacramento River Index (SRI) (Figure 6). Valley Water uses historical SRI water year types to model hydrologic conditions in Santa Clara County as it reflects conditions in the Sierra and the Sacramento-San Joaquin Delta that influence Valley Water's imported water deliveries. Rainfall stations within Santa Clara County confirm that the rainfall season from July 1, 2018 to June 30, 2019 was above the historical average. For instance, rainfall in downtown San Jose (Station 131) was approximately 15.7 inches or 131% of average.

Figure 6. Water Year Types from WY 1936 to 2019 – Sacramento River Index (SRI)



Water Year Types per DWR SRI: 1 (Critical); 2 (Dry); 3 (Below Normal); 4 (Above Normal); 5 (Wet)

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CHAPTER 3 – WATER SUPPLY AND USE

Valley Water manages a diverse water supply portfolio, with sources including groundwater, local surface water, imported water, and recycled water. About half of the county's water supply comes from local sources with the other half from imported sources. Imported water includes Valley Water's State Water Project (SWP) and Central Valley Project (CVP) contract supplies and supplies delivered by the San Francisco Public Utilities Commission (SFPUC) to northern Santa Clara County. Local sources include natural groundwater recharge and surface water supplies. A smaller but growing portion of the county's local water supply is recycled water.

Valley Water distributes local and imported surface water supplies to managed recharge facilities, three drinking water treatment plants, local creeks for environmental needs, or directly to water users. The conjunctive management of surface water and groundwater maximizes water supply reliability, allowing Valley Water to store surface water in local groundwater basins to help balance pumping and provide reserves for use during dry years or water shortages.

3.1 Groundwater Extraction

Total groundwater pumping in WY 2019 was 109,600 AF, providing 37% of the water used by county residents and businesses. Figure 7 shows the location and volume of groundwater pumping, and Table 1 summarizes pumping by subbasin, water use category, and measurement method and accuracy.

About 67,200 AF of groundwater was pumped in the Santa Clara Subbasin, with almost 95% of that supporting municipal and industrial (M&I) uses (Table 1). Agricultural and domestic use totaling 4,100 AF was mostly in the more rural Coyote Valley in the southern Santa Clara Subbasin. Total pumping in the Llagas Subbasin was 42,400 AF. In this subbasin, agricultural use was more significant (23,500 AF), accounting for 55% of the total pumping. M&I groundwater use was 17,000 AF or 40% of subbasin pumping. While the quantity of groundwater used for domestic purposes was relatively small in the Llagas Subbasin (1,800 AF or 4%), over 2,600 individual domestic wells reported groundwater use in WY 2019.

Groundwater pumped from the subbasins is recorded in accordance with the Santa Clara Valley Water District Act. This act requires well owners and operators to register all wells within the county and to file monthly, semi-annual, or annual production statements for water-producing wells within Valley Water's groundwater benefit zones, with reporting frequency dependent on the amount of water produced. By Valley Water Board Resolution, meters are only installed at those sites determined to be economically feasible per approved criteria or as required to facilitate the complete and accurate collection of groundwater production revenue. In the northern Zone W-2, which essentially overlaps the northern Santa Clara Subbasin (Santa Clara Plain groundwater management area), meters are required for facilities producing more than 4 AF of agricultural water or more than 1 AF of non-agricultural water annually. Within Zone W-5 (essentially coincident with the Coyote Valley groundwater management area of the Santa Clara Subbasin, and the Llagas Subbasin), meters are required for facilities producing more than 20 AF of agricultural water or more than 2 AF of non-agricultural water.

Metered wells extracted the vast majority (97,900 AF or 89%) of the groundwater pumped in WY 2019. Where meters were not used, crop factors were used to determine agricultural water use, whereas domestic use was estimated from a table of average uses.

Figure 7. WY 2019 Groundwater Pumping in the Santa Clara and Llagas Subbasins

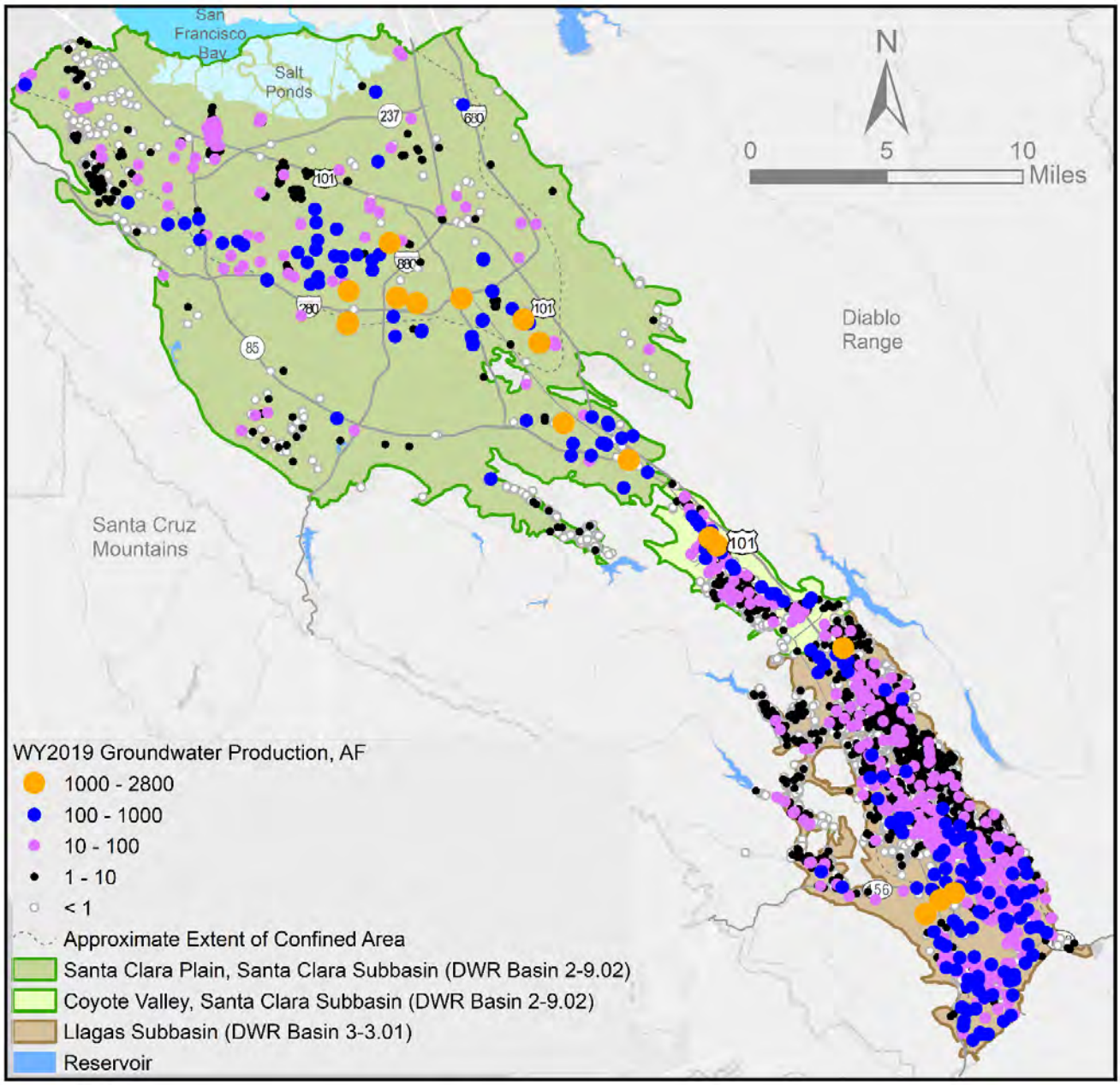

Table 1. WY 2019 Groundwater Pumping (AF) by Water Use

Water Use Sector	Measurement Method	Santa Clara Subbasin	Llagas Subbasin	Total Pumping	Accuracy
M&I	Metered	61,600	16,400	78,000	Within 2%
	Estimated	1,500	600	2,100	N/A
Domestic	Metered	100	200	300	Within 2%
	Estimated	400	1,700	2,100	N/A
Agricultural	Metered	2,700	16,900	19,600	Within 2%
	Estimated	900	6,600	7,500	N/A
Total		**67,200**	**42,400**	**109,600**	

Notes:

- As shown above, the majority of groundwater pumping is metered. Smaller pumpers are required to report production semi-annually or annually on a fiscal year (July 1 – June 30) basis. Non-metered pumpers report groundwater pumping based on crop factors (agricultural use) or table of average uses (domestic use). In this table, estimated pumping shown for the water year is based on fiscal year reporting and typical pumping patterns.
- All values are rounded to the nearest hundred.

3.2 Surface Water Supply Used

In WY 2019, Valley Water actively recharged about 81,400 AF of imported and local surface water in the Santa Clara and Llagas subbasins. Valley Water also provided about 105,000 AF of in-lieu recharge in the form of treated surface water deliveries to retailers (cities and water companies) and raw surface water deliveries to customers (Table 2). This is in addition to SFPUC deliveries to eight water retailers overlying the Santa Clara Subbasin and recycled water deliveries by Valley Water and four recycled water producers in the county, which totaled 60,400 AF countywide (Table 2). Valley Water's long-term water conservation programs also saved more than 70,000 AF, which further reduced the demand on groundwater.

Valley Water Managed Recharge

Valley Water replenishes the groundwater subbasins with imported water and watershed runoff captured in 10 local reservoirs. Valley Water's recharge facilities include more than 300 acres of recharge ponds and over 90 miles of creeks. Imported sources include the SWP and the federal CVP. The volumes of imported or local water used for managed recharge each year depend on many factors including hydrology, imported water allocations, treatment plants demand, and environmental needs. In general, a greater percentage of local water is used for recharge in wet years due to increased capture of storm runoff in local reservoirs. In WY 2019, Valley Water recharged about 58,400 AF of local and imported water in the Santa Clara Subbasin and about 23,000 AF in the Llagas Subbasin.

In-Lieu Use of Surface Water Supplies

Valley Water's treated and raw surface water deliveries, SFPUC supplies to local retailers, and recycled water programs play a critical role in maintaining groundwater elevations and storage by reducing demands on groundwater. Table 2 summarizes the supplies from these categories in areas that were historically primarily or solely served by groundwater.

3.3 Total Water Use

Total water use in Santa Clara County in WY 2019 is summarized in Table 2, which includes water use categories, measurement methods and accuracy, water sources, and use sectors. While the county boundary extends beyond the subbasins, the vast majority of the population and associated water use coincides with the subbasins.

Table 2. Santa Clara County Total Water Use in AF for WY 2019

Water Use[1]	Santa Clara Subbasin	Llagas Subbasin	County-wide	Measurement Method	Accuracy	Source	Sector
Groundwater Pumped	67,200	42,400	109,600	Metered (89%) and estimated[2]	Within 2% (metered)	Natural recharge, managed recharge of local runoff and imported (SWP/CVP) water	M&I, domestic and agricultural[3]
Valley Water Treated Water Deliveries	103,000	0	103,000	Metered	Within 2%	Local runoff and imported (SWP/CVP) water	M&I
Valley Water Raw Surface Water Deliveries	700	1,300	2,000	Metered (95%) and estimated[2]	Within 2% (metered)	Local runoff and imported (SWP/CVP) water	M&I, domestic and agricultural
SFPUC Supplies to Local Retailers[4]	43,300	0	43,300	Metered	Within 1.5%	Surface water reservoirs[5]	M&I
Recycled Water	15,200	1,900	17,100	Metered	Variable[6]	Treated wastewater	M&I and agricultural
Total[7]	**229,400**	**45,600**	**275,000**				

[1] All water use values are rounded to the nearest hundred.
[2] Production from some smaller wells and raw surface water users is estimated using a table of average uses or crop factors.
[3] Groundwater use by sector is shown in Table 1.
[4] San Francisco Public Utilities Commission (SFPUC) supplies water to eight (8) retailers in Santa Clara County and NASA-AMES (https://sfwater.org/index.aspx?page=355).
[5] SFPUC primary sources are surface water reservoirs with runoff mainly from the Hetch Hetchy watershed and also from the Alameda and Peninsula watersheds. More information is available at: https://sfwater.org/index.aspx?page=355.
[6] Recycled water meter accuracy varies as each of the four producers within the county uses different methods to measure production and delivery of recycled water.
[7] Local water rights used by the San Jose Water Company (SJWC) and Stanford within the Santa Clara Subbasin are not reflected in the total because their local water rights have historically amounted to <3% of the total for the Santa Clara Subbasin.

3.4 Change in Groundwater Storage

Due to good water supply conditions, robust managed recharge, and continued lower groundwater use since the drought, Valley Water estimates a net increase in countywide groundwater storage of 18,000 AF in WY 2019 compared to WY 2018. Storage increased by 11,400 AF in the Santa Clara Subbasin and by 6,600 AF in the Llagas Subbasin. Groundwater storage is the primary trigger for action under Valley Water's Water Shortage Contingency Plan, and storage remained well in the "Normal" stage (e.g., no shortage response required) in WY 2019.

Figure 8 depicts the change in groundwater elevation from October 2018 to September 2019 at more than 200 principal aquifer water level wells in the Santa Clara Subbasin and more than 45 wells in the Llagas Subbasin, respectively. The corresponding change in storage of 18,000 AF for the Santa Clara and Llagas subbasins, as estimated from Valley Water's calibrated groundwater flow models, is also shown in Figure 8.

Figures 9 and 10 present the water year type, groundwater use, annual change in groundwater storage, and cumulative change in groundwater storage for the Santa Clara and Llagas subbasins, respectively, from WY 1991 through WY 2019. These figures show that over this period, the annual change within each basin has most frequently been an increase in groundwater storage. The most notable exceptions, also evident in hydrographs, occur during droughts, as expected. However, Valley Water programs to recharge and manage groundwater support fairly rapid recovery of water levels and storage, helping ensure long-term sustainability. As mentioned previously, groundwater levels and storage in the Santa Clara and Llagas subbasins recovered from the 2012-2016 drought, with groundwater elevations far above historical minima and drought levels, and strong artesian pressures observed in the northern Santa Clara Subbasin.

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Figure 8. Change in Groundwater Elevation and Storage from October 2018 to September 2019

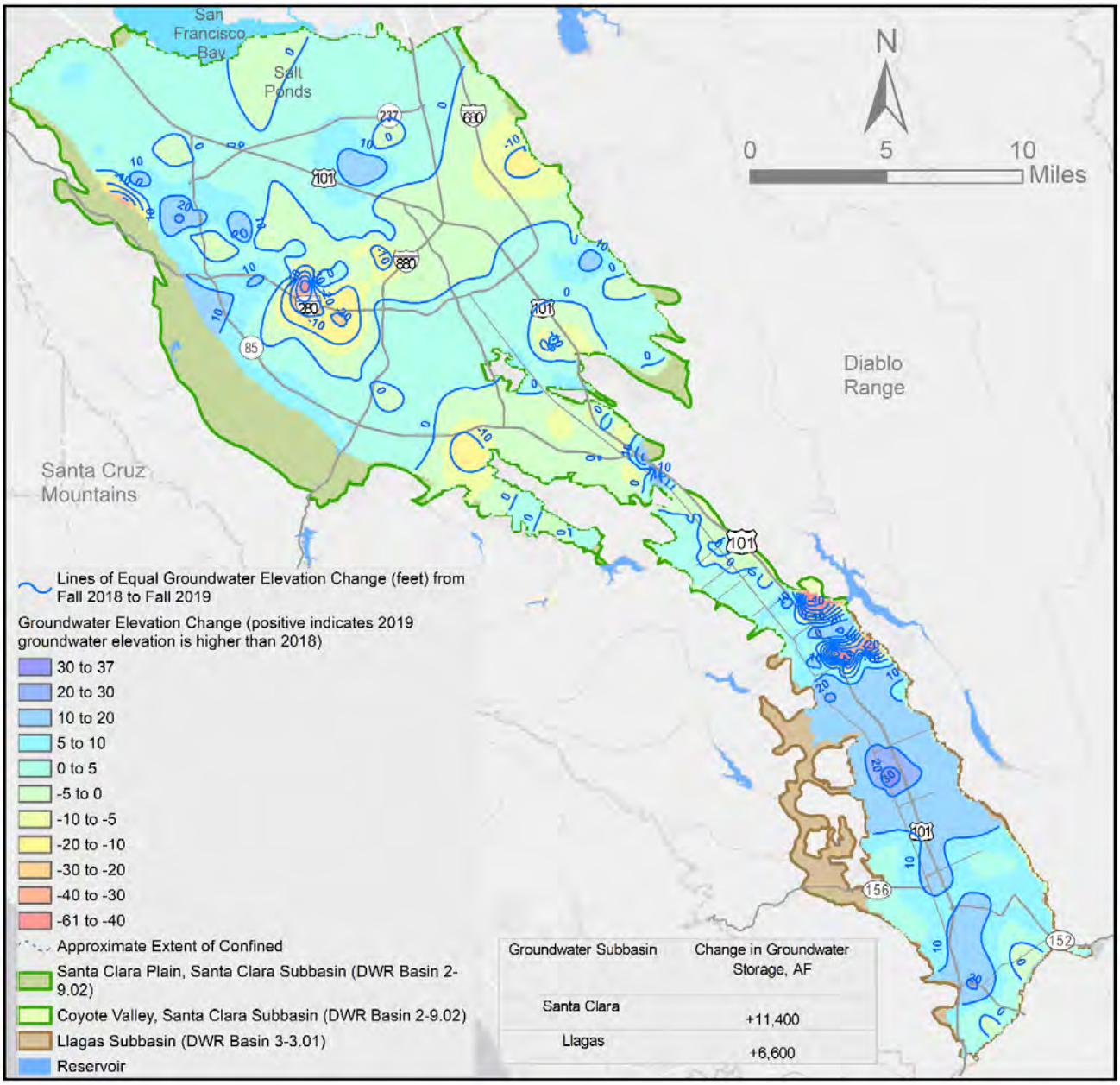
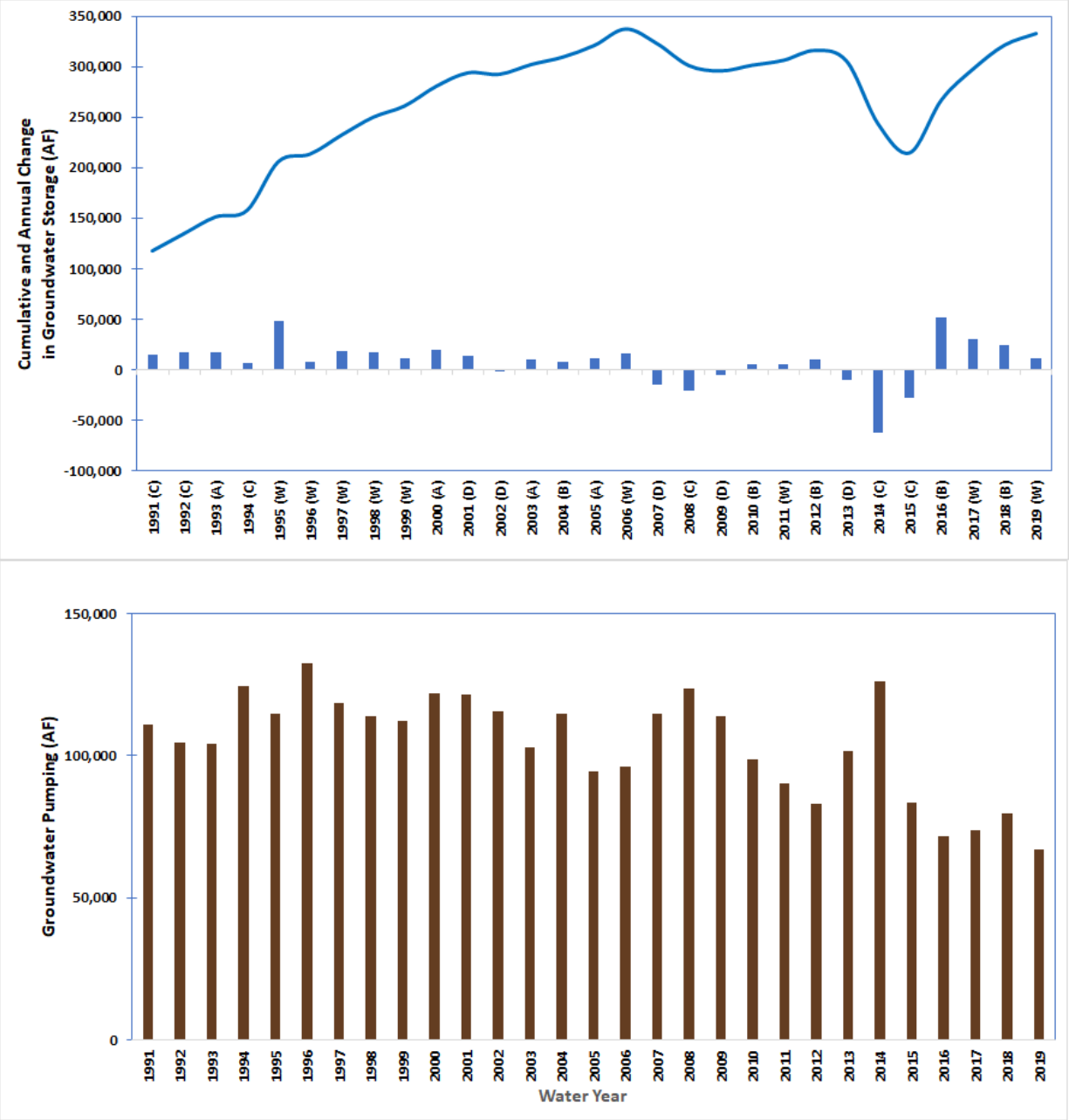


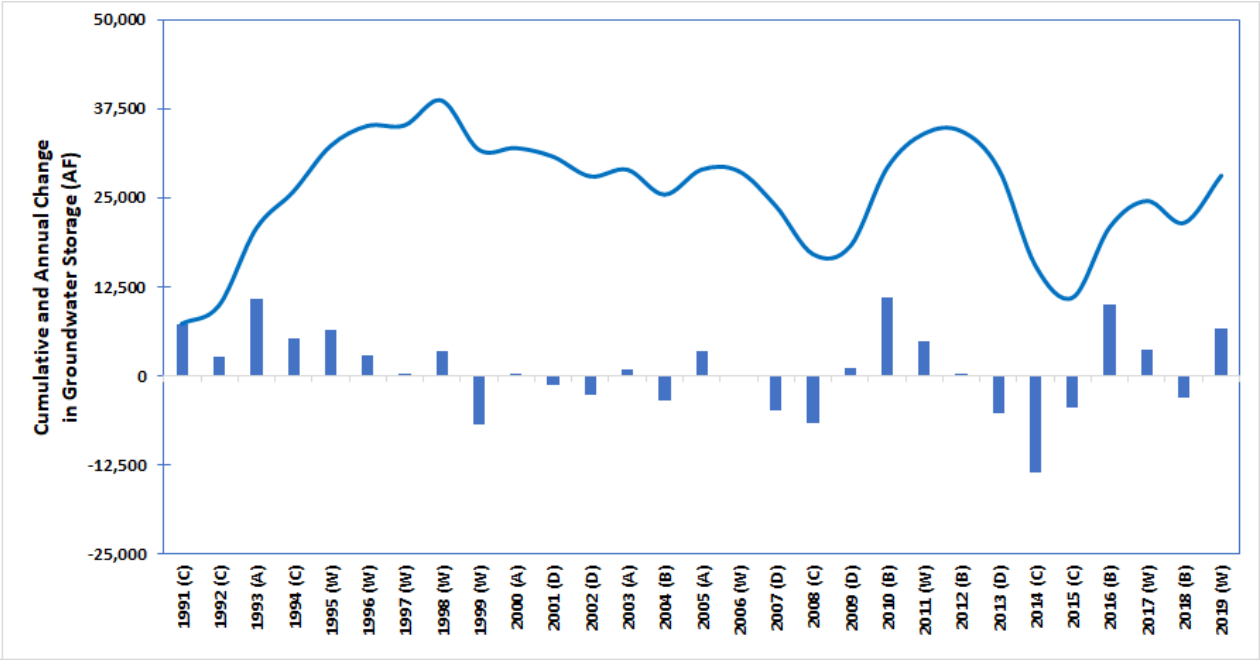
Figure 9. Groundwater Use and Change in Storage in the Santa Clara Subbasin

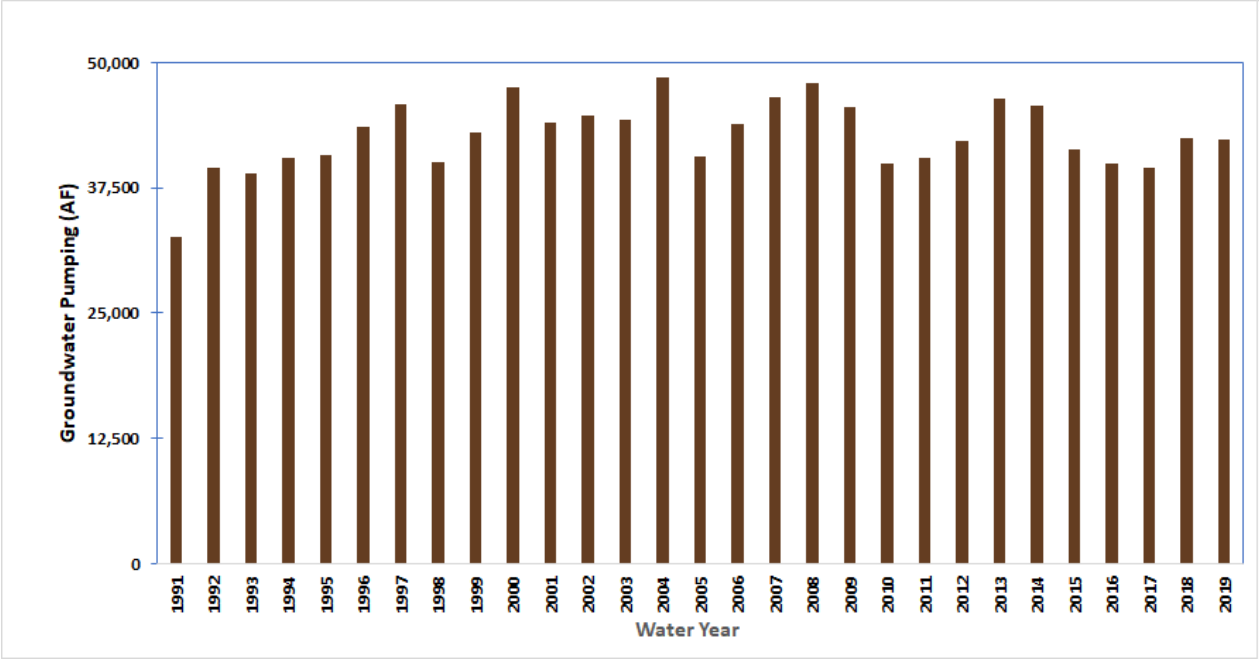


Notes:

- DWR SRI water year types are: Critical (C), Dry (D), Below Normal (B), Above Normal (A), and Wet (W).
- The storage graph begins in 1991 because Valley Water estimates Santa Clara Subbasin storage using two numerical models. The Santa Clara Plain model for the northern Santa Clara Valley begins in 1970 while the Coyote Valley model for the southern part of the subbasin begins in 1991 as Valley Water did not begin managing that area until the late 1980s.
- Most groundwater pumping is reported monthly and is reported here by water year. However, pumpers that report semi-annually or annually provide data based on the fiscal year (July 1 to June 30). For these reporters, groundwater pumping shown in this figure represents the fiscal year, which is presumed to be similar to the water year.

Figure 10. Groundwater Use and Change in Storage in the Llagas Subbasin





Notes:

- DWR SRI water year types are: Critical (C), Dry (D), Below Normal (B), Above Normal (A), and Wet (W).
- The storage graph begins in 1991 because Valley Water estimates Llagas Subbasin storage using a numerical model that begins in 1991 as Valley Water did not begin managing that area until the late 1980s.
- Most groundwater pumping is reported monthly and is reported here by water year. However, pumpers that report semi-annually or annually provide data based on the fiscal year (July 1 to June 30). For these reporters, groundwater pumping shown in this figure represents the fiscal year, which is presumed to be similar to the water year.

CHAPTER 4 – PLAN IMPLEMENTATION

Valley Water continues to implement the comprehensive conjunctive management, groundwater monitoring, and groundwater protection programs described in the Plan. As a result, groundwater levels and storage in the Santa Clara and Llagas subbasins fully recovered to pre-drought conditions and remain healthy and sustainable.

The Plan presents six major recommendations to maintain the long-term viability of groundwater resources. A summary of the status of each recommendation is below.

1. **Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.**

   This Plan recommendation has several sub-recommendations, including items related to infrastructure reliability, high-priority capital project implementation, and securing imported water sources, among others. Valley Water continues to focus on extensive groundwater recharge through direct replenishment and in-lieu recharge. Updates relative to this Plan recommendation are presented below.

   Capital Projects Supporting Conjunctive Management
   Valley Water continues to implement a comprehensive Capital Improvement Program (CIP). Valley Water's Fiscal Year Draft 2021-25 Five-Year CIP was approved for release on February 25, 2020.[10] With a significant portion of Valley Water's water supply infrastructure approaching fifty to sixty years of age, maintaining and upgrading the existing infrastructure to ensure each facility functions as intended for its useful life became the focus of the Water Supply CIP in recent years. Other CIP projects focus on expanding in-lieu and direct recharge through recycled and purified water projects. Major water supply capital improvements identified in the CIP include:

   Storage:
   - Almaden Dam Improvements
   - Anderson Dam Seismic Retrofit
   - Calero Dam Seismic Retrofit
   - Guadalupe Dam Seismic Retrofit
   - Pacheco Reservoir Expansion

   Transmission:
   - 10-Year Pipeline Rehabilitation
   - Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Implementation
   - Vasona Pumping Plant Upgrade
   - Almaden Valley Pipeline Replacement

[10] The draft 2021-25 CIP is available at: https://www.valleywater.org/how-we-operate/five-year-capital-improvement-program

Treatment:
- Penitencia Water Treatment Plant Residuals Management
- Rinconada Water Treatment Plant Reliability Improvement
- Santa Teresa Water Treatment Plant Filter Media Replacement
- Water Treatment Plant Electrical Improvement

Recycled Water:
- Expedited Purified Water Program
- South County Recycled Water Pipeline

Detailed information on each of these water supply capital projects, including related description, costs, and schedule, is available in the CIP.

2. **Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.**

Sub-recommendations from the Plan include continued groundwater quality monitoring, action when potentially adverse trends are identified, and continued/enhanced collaboration with local partners and stakeholders.

Groundwater quality is typically very good in the county, with no treatment beyond disinfection required at major retailer wells. However, nitrate remains an ongoing groundwater protection challenge, particularly in the more rural Coyote Valley and Llagas Subbasin. Valley Water continues to conduct extensive groundwater quality monitoring, evaluate long-term trends, and compare current conditions against regulatory standards and projected concentrations (such as from Salt and Nutrient Management Plans). Detailed information and analysis of all monitoring data is presented in Valley Water's Annual Groundwater Report, which is calendar-year based and published each summer.[11]

Long-term trends are favorable for nitrate, with about 90% of wells tested showing stable or decreasing concentrations. However, since a significant number of domestic wells in the Llagas Subbasin still contain nitrate above the drinking water standard, more work remains to be done. Valley Water offers rebates of up to $500 for nitrate treatment systems and will continue to engage with regulatory and land use agencies to address existing nitrate contamination. For nitrate and other water quality issues, Valley Water will work to build and enhance this collaboration to protect high-quality groundwater and expedite the restoration of impacted groundwater.
In 2019, Valley Water worked with land use agencies to finalize a Stormwater Resources Plan[12] that will increase infiltration while ensuring pollutants from urban runoff are not merely transmitted from surface water

[11] The comprehensive Annual Groundwater Report for each calendar year is available at www.valleywater.org/groundwater.
[12] Santa Clara Basin Stormwater Resource Plan, Final August 2019 is available at https://scvurppp.org/wp-content/uploads/2019/08/SCB_SWRP_FINAL_8-20-19.pdf

to groundwater. Similarly, Valley Water continues to engage with various entities to ensure that recycled water expansion or the use of purified water for recharge will be protective of groundwater quality.

Engaging with land use and regulatory agencies on proposed policy, legislation, and projects that may impact groundwater remains a key strategy for protecting groundwater. For example, Valley Water tracks the progress of major contaminant release sites, interacting with regulatory agencies to promote expedited and thorough cleanup. Valley Water also engages with land use agencies on relevant projects and policies such as development, stormwater infiltration devices, septic systems, and small water systems.

Public outreach continues to be an important component of Valley Water's groundwater protection efforts. In WY 2019, Valley Water celebrated Groundwater Awareness Week by highlighting groundwater on the Valley Water website and posting related social media messages. Valley Water also maintained its status as a Groundwater Guardian through a program sponsored by the non-profit Groundwater Foundation. This is an annually earned designation for communities and affiliates that take voluntary, proactive steps toward groundwater protection.

To provide information on well sampling by Valley Water and local water suppliers, Valley Water prepared the 2018 Groundwater Quality Summary.[13] This annual report is similar to water retailer consumer confidence reports and provides basic groundwater quality information to domestic well owners who do not typically receive water from a water retailer.

Other groundwater-related public outreach conducted by Valley Water in WY 2019 included:

- Interaction with thousands of students through the Education Outreach program.
- Direct communication with well owners on groundwater quality, well maintenance, and treatment systems under the Domestic Well Testing and Nitrate Treatment System Rebate programs.

3. Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.

This Plan recommendation focuses on continued, thoughtful water supply planning and investments. In November 2019, Valley Water completed an update to the Water Supply Master Plan 2040[14], which explains Valley Water's strategy for providing a reliable and sustainable water supply into the future. The Water Supply Master Plan 2040 informs investment decisions and provides a framework for annually monitoring the water supply strategy to ensure it will meet the water needs of Santa Clara County. Staff held multiple workshops with water retailers and stakeholders and presented information to the Board and the Board's Water Conservation and Demand Management Committee on numerous occasions. These presentations have included information on the proposed level of service goal and potential water supply investment strategies. The Valley Water

[13] The 2018 Groundwater Quality Summary Report is available at https://www.valleywater.org/sites/default/files/2019-07/2019%20Groundwater%20Quality%20Report%20Shell_Web_Version_0.pdf
[14] Santa Clara Valley Water District, Water Supply Master Plan 2040 is available at https://www.valleywater.org/sites/default/files/Water%20Supply%20Master%20Plan%202040_11.01.2019_v2.pdf

investment strategy includes securing existing supplies, expanding water conservation and reuse, and optimizing the system. Projects approved by the Board for planning include advanced metering infrastructure, leak repair incentives, expansion of Valley Water's graywater program, a model water-efficient ordinance for new developments, decentralized stormwater capture (e.g., incentives for rain barrels, cisterns, and rain gardens), and centralized stormwater capture (e.g., flooding of agricultural lands), 24 thousand acre-feet of potable reuse, the Delta Conveyance Project, expanding Pacheco Reservoir, and the Transfer-Bethany Pipeline. Details about each of these projects can be found in Appendix H of the Water Supply Master Plan 2040.

Groundwater sustainability also remains an important factor during the planning and implementation of multi-benefit projects under Valley Water's One Water Plan[15]. The Sustainable Groundwater and Water Quality objectives of the One Water Plan align with the Plan outcome measures and the process to identify individual projects on the watershed scale (e.g., Coyote Watershed) accounts for groundwater conditions and sustainability.

To support managed response to climate change, Valley Water is developing a Climate Change Action Plan (CCAP) that will be completed in 2020. The CCAP will include comprehensive review of climate change as it relates to Valley Water core services and include goals, strategies, and possible actions to respond to climate change. The CCAP will identify potential future climate change vulnerabilities and risks to all core service areas, including water supply and groundwater management. The CCAP will provide goals and strategies to reduce risks to Valley Water core services and its mission. The strategies will be incorporated into existing Valley Water plans, budgets, and long-term financial forecasts as appropriate.

4. Maintain adequate monitoring programs and modeling tools.

This Plan recommendation focuses on improving monitoring networks by identifying and addressing gaps, redundancies, and access issues; identifying and implementing improvements to the numerical groundwater flow models; and improving Valley Water's understanding of surface water/groundwater interaction and groundwater dependent ecosystems (GDEs). In addition to the comprehensive, calendar-year based Annual Groundwater Report, Valley Water produces high-level monthly Water Tracker[16] and groundwater condition reports[17] help keep stakeholders informed about current groundwater conditions including groundwater pumping, recharge, and water levels.

Valley Water continues to offer free basic well testing for domestic well owners to supplement regional groundwater quality monitoring, which emphasizes the use of consistent wells. Through this voluntary program, Valley Water obtains valuable data on nitrate and other contaminants while providing important water quality data to about 200 private well owners each year. Valley Water is evaluating the recycled water and recharge

[15] https://onewaterplan.wordpress.com/
[16] https://www.valleywater.org/your-water/water-supply-planning/monthly-water-tracker
[17] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-monitoring

water quality monitoring networks to ensure they meet monitoring objectives in terms of frequency, locations, and constituents analyzed.

Valley Water uses three calibrated groundwater flow models – one for each groundwater management area (Santa Clara Plain, Coyote Valley, and the Llagas Subbasin). These models are used to evaluate groundwater storage and levels to inform operational decisions and long-term planning efforts. Staff is assessing each model to identify related improvements or enhancements that may be needed or desired to improve the use of these tools.

Regarding surface water/groundwater interaction, Valley Water staff has begun to evaluate existing available data for stream gauging and groundwater levels. Valley Water is also evaluating whether existing wells adjacent to creeks may be useful in collecting additional data to better understand the interaction. Staff has attended workshops organized by DWR and reviewed both relevant literature and how other GSAs are working to better understand groundwater-surface water interaction. Staff has also performed preliminary experiments to measure the flux between surface water and groundwater. Valley Water will continue to explore the complex and dynamic interaction between surface water and groundwater and will engage interested stakeholders. This issue will be further documented in the five-year Groundwater Management Plan update, which is due by January 1, 2022.

5. **Continue and enhance groundwater management partnerships with water retailers and land use agencies.**

This Plan recommendation focuses on continued collaboration and strong partnerships with water retailers and land use agencies. Valley Water continues to interact regularly with water retailers through quarterly Water Retailer meetings, including the Groundwater Subcommittee. In addition to these regular meetings, Valley Water and water retailers collaborate on various issues that arise regarding groundwater, treated water, wells, and water measurement.

Valley Water also continues to coordinate with local land use agencies on General Plans, water supply assessments, Urban Water Management Plans, stormwater management, and various individual land use projects. Land use decisions fall under the authority of the local cities and the County of Santa Clara. Valley Water reviews land use and development plans related to Valley Water facilities and watercourses under Valley Water jurisdiction and provides technical review for other land use proposals as requested by the local agency. When provided by land use agencies, water supply assessments for new developments are also reviewed and evaluated in the context of Valley Water's long-term water supply plans. For all reviews, Valley Water's groundwater-related comments focus on potential impacts to groundwater quality and sustainability.

6. Evaluate the potential new authorities provided by SGMA.

The Santa Clara Valley Water District Act provides broad authorities, but there are additional authorities under SGMA including the ability to regulate pumping or impose various types of fees. This Plan recommendation focused on the evaluation of these new SGMA authorities in cooperation with water retailers and other interested stakeholders to consider what conditions might necessitate their implementation to sustainably manage groundwater into the future.

As first described in the WY 2017 Annual SGMA Report submitted to DWR, Valley Water has explored new SGMA authorities with interested stakeholders through the Board's Water Conservation and Demand Management Committee (Committee). Nine publicly noticed Committee meetings between December 2016 and December 2017 provided a transparent forum for discussion with interested stakeholders on how and when these authorities might be used.

The potential regulation of pumping or well construction is a complex and controversial topic, which was discussed extensively through Committee meetings. Existing groundwater management programs and strong partnerships with large pumpers are expected to result in continued sustainable conditions and are the preferred way to address future challenges. However, pumping regulation may be needed in the future to address undesirable results. The primary SGMA-related work product from the Committee meetings was a process that describes the fundamental approach to respond to potential worsening basin conditions. This includes the steps that would be taken prior to implementing SGMA authorities to regulate groundwater pumping, with a focus on providing some certainty on the process, while avoiding prescriptive requirements that may not be effective in addressing a future issue. This process was memorialized via a resolution adopted by Valley Water Board on February 27, 2018. This resolution was included as Attachment 2 in the WY 2018 Annual SGMA report to DWR.

Valley Water also explored the potential to implement a fixed charge as a component of groundwater production charges, which are currently volumetric charges. This could potentially reduce volatility in rates and revenues based on changes in water use. Valley Water engaged a consultant to develop a fixed charge proposal and assist with implementation. However, major water retailers expressed significant concerns, including redundancy with other charges or charge adjustment mechanisms, equity in applying the charge to all well users, and potential cost recovery impacts to retailers regulated by the California Public Utilities Commission. After discussing these concerns with the Committee and the full Board, Valley Water is unlikely to further pursue a fixed charge at this time.

NEXT STEPS

Valley Water will continue to submit annual reports required under SGMA to DWR by the April 1 deadline. In addition to this brief report, Valley Water will also continue to publish a comprehensive, calendar-year based Annual Groundwater Report each summer with more detailed information on pumping, recharge, water balance, groundwater levels and storage, land subsidence and groundwater quality. The most recent report, the Annual

Groundwater Report for Calendar Year (CY) 2018, is posted on the Valley Water website, and will be replaced with the CY 2019 Report in the summer of 2020.[18]

Ensuring continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley a safe, clean water supply for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion," in accordance with Board policy.

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[18] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater

Valley Water

Santa Clara Valley Water District
5750 Almaden Expressway, San Jose, CA 95118-3686
Phone: (408) 265-2600 Fax: (408) 266-0271
www.valleywater.org

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Valley Water

Clean Water • Healthy Environment • Flood Protection

Santa Clara Valley Water District
5750 Almaden Expressway, San José, CA 95118-3686
Phone: (408) 265-2600 Fax: (408) 266-0271
www.valleywater.org

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Appendix F – Board Resolution No. 18-04

Board Resolution 18-04 Memorializing the Process to Regulate Groundwater Extraction Under the Sustainable Groundwater Management Act, if Needed

File No.: 18-0023

Agenda Date: 2/27/2018
Item No.: 5.1.

BOARD AGENDA MEMORANDUM

SUBJECT:
Resolution Memorializing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed.

RECOMMENDATION:
Adopt the Resolution MEMORIALIZING THE PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED.

SUMMARY:
The Santa Clara Valley Water District (District) has sustainably managed the Santa Clara and Llagas subbasins for many decades under the authority of the District Act. The Sustainable Groundwater Management Act (SGMA), enacted by the state in 2014, requires local agencies to develop and implement plans to sustainably manage groundwater and provides them with various, related authorities.

The proposed resolution (Attachment 1) and the accompanying presentation (Attachment 2) lay out a proposed process for the District, in coordination with stakeholders, to address worsening basin conditions through a process that may rely on SGMA authorities to regulate groundwater extraction.

BACKGROUND:
To comply with SGMA planning requirements, the District developed the 2016 Groundwater Management Plan for the Santa Clara and Llagas Subbasins (GWMP) as a prescribed alternative to a Groundwater Sustainability Plan. The GWMP describes the subbasins, as well as groundwater management goals, strategies, programs, and numeric outcome measures. It also recognizes new SGMA authorities, like the ability to regulate groundwater extraction and collect different fees, as potential tools to support continued sustainability. On November 22, 2016, the District Board of Directors (Board) adopted the GWMP following a public hearing. Several related comment letters expressed concerns with water rights and the potential regulation of pumping. The Board referred stakeholder engagement in evaluating new SGMA authorities to the Water Conservation and Demand Management Committee (Committee).

The Committee met nine times between December 2016 and December 2017 to evaluate new SGMA authorities in coordination with water retailers and other interested stakeholders. Through this open forum and with retailer and stakeholder participation, the Committee developed a process (an

implementation framework) for groundwater extraction regulation, which is included in the attached resolution (Attachment 1).

As noted in Attachment 1, the existing groundwater management framework is expected to support continued, sustainable groundwater conditions. Pumping regulation may never be needed. The attached process describes the fundamental approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction. The focus is on providing certainty as to the process, while avoiding prescriptive requirements that may not be appropriate or effective.

The District's GWMP is currently being evaluated by the California Department of Water Resources to determine whether it meets SGMA planning requirements. If it is determined to be an acceptable alternative to a Groundwater Sustainability Plan, the District will need to update the GWMP every five years, with the next update scheduled for 2021. To ensure the process developed by the Committee is adequately documented prior to this update, staff recommends that the Board adopt the resolution Memorializing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed (Attachment 1).

FINANCIAL IMPACT:
There is no financial impact associated with this item.

CEQA:
The recommended action does not constitute a project under CEQA because it does not have a potential for resulting in direct or reasonably foreseeable indirect physical change in the environment.

ATTACHMENTS:
Attachment 1: Resolution
Attachment 2: PowerPoint

UNCLASSIFIED MANAGER:
Garth Hall, 408-630-2750

BOARD OF DIRECTORS
SANTA CLARA VALLEY WATER DISTRICT

RESOLUTION NO. 18- 04

RESOLUTION MEMORIALIZING THE PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

WHEREAS, the Santa Clara Valley Water District Act (California Water Code Appendix, Chapter 60) provides the District with broad groundwater management authority, including the authority to protect, spread, store, retain, and cause water to percolate in the soil within Santa Clara County; and

WHEREAS, on September 16, 2014, the Sustainable Groundwater Management Act (SGMA) was signed into law and adopted into the California Water Code, commencing with Section 10720; and

WHEREAS, Water Code Section 10720.1 states that, in enacting SGMA, the intent of the legislature is to provide for the sustainable management of groundwater basins, to enhance local management of groundwater consistent with rights to use or store groundwater, to establish minimum standards for sustainable groundwater management, to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater, and to achieve other listed intents; and

WHEREAS, on May 24, 2016, the District Board of Directors adopted Resolution 16-51 on the Decision to Become the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas Subbasins; and

WHEREAS, on June 13, 2017, the District Board of Directors adopted Resolution 17-38 on the Decision to Become the GSA for the Portions of the Hollister and San Juan Bautista Subbasins Located Within Santa Clara County; and

WHEREAS, Water Code Section 10733.6(b)(1) identifies a plan developed pursuant to Part 2.75 (commencing with Section 10750) or other law authorizing groundwater management as an acceptable alternative to a Groundwater Sustainability Plan; and

WHEREAS, the 2016 Groundwater Management Plan (GWMP) describes the District's comprehensive framework to ensure continued, sustainable groundwater conditions in the Santa Clara and Llagas Subbasins; and

WHEREAS, on November 22, 2016, the District Board of Directors adopted the GWMP through Resolution 16-78; and

WHEREAS, the District submitted the GWMP to the California Department of Water Resources as an alternative pursuant to SGMA; and

WHEREAS, the GWMP acknowledges new authorities granted by SGMA, including the potential to regulate groundwater extraction, control well spacing or operation, and collect different types of fees, within the constraints identified in SGMA; and

WHEREAS, the existing groundwater management framework, which includes coordination with water retailers and other stakeholders, is expected to support continued, sustainable groundwater conditions; and

WHEREAS, the District Board of Directors directed the Water Conservation and Demand Management Committee (Committee) to engage stakeholders in evaluating the new SGMA authorities as potential tools that may be needed to ensure continued sustainability; and

WHEREAS, the Committee engaged water retailers and other interested stakeholders during nine publicly-noticed meetings between December 2016 and December 2017; and

WHEREAS, the Committee considered stakeholder input in developing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed, attached hereto as Exhibit A; and

WHEREAS, the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed, describes the approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction.

NOW, THEREFORE BE IT RESOLVED that the Board of Directors of the Santa Clara Valley Water District:

1. Hereby adopts the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed; and

2. All the recitals in this Resolution are true and correct and the District so finds, determines, and represents.

PASSED AND ADOPTED by the Board of Directors of the Santa Clara Valley Water District by the following vote on February 27, 2018:

AYES: Directors N. Hsueh, T. Estremera, B. Keegan, G, Kremen, L. LeZotte, J. Varela, R. Santos

NOES: Directors None

ABSENT: Directors None

ABSTAIN: Directors None

SANTA CLARA VALLEY WATER DISTRICT

By: Richard P. Santos
RICHARD P. SANTOS
Chair/Board of Directors

ATTEST: MICHELE L. KING, CMC

Michele L. King
Clerk/Board of Directors

EXHIBIT A
COVERSHEET

PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

No. of Pages:	6
Exhibit Attachment:	Attachment 1: Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed

PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

INTRODUCTION

The Santa Clara Valley Water District (District) has sustainably managed the Santa Clara and Llagas Subbasins for many decades under the authority of the District Act. In 2014, the Sustainable Groundwater Management Act (SGMA) was enacted as California's first comprehensive, statewide regulatory program for groundwater. SGMA provides Groundwater Sustainability Agencies (GSAs), like the District, with various authorities to manage groundwater.

SGMA authorities include the ability to regulate pumping and assess different types of groundwater charges. These authorities have been discussed in various meetings of the District Board of Directors (Board) Water Conservation and Demand Management Committee (Committee) in an open forum and with input from interested stakeholders.

The existing, proven groundwater management approach, which includes strong partnerships with large groundwater pumpers, is expected to result in continued, sustainable groundwater management in the future and is the preferred approach to addressing future challenges. This document describes the approach to implementing SGMA authorities to regulate groundwater extraction, should such regulation become needed in the future.

BACKGROUND

SGMA established new requirements for GSAs, including the development of Groundwater Sustainability Plans (GSPs) or prescribed Alternatives. In 2016, the District prepared the 2016 Groundwater Management Plan (GWMP), which was approved by the Board following a public hearing on November 22, 2016. The District submitted the GWMP as an alternative to a GSP to the California Department of Water Resources (DWR) in December 2016. The GWMP acknowledged the new SGMA authorities and committed the District to work collaboratively with groundwater pumpers and other stakeholders to further evaluate the authorities. The Board referred related stakeholder engagement to the Committee.

The Committee, stakeholders, and the Board have indicated interest in the use of a fixed charge as a component of the groundwater production charge, and the District will further explore this concept. Committee items on the potential regulation of pumping and related discussion with stakeholders have led to the development of this process, or implementation framework.

SGMA provides GSAs with various authorities to ensure groundwater management and use do not cause undesirable results, which are defined as one of more of the following per Water Code §10721:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon.
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Per Water Code §10726.4(a), in regulating groundwater extraction, SGMA allows a GSA to:

1. impose spacing requirements on new wells and impose reasonable operating regulations on existing wells to minimize well interference by restricting or suspending well production;
2. control groundwater extractions by regulating, limiting, or suspending extractions, new well construction, well enlargement, or abandoned well reactivation, or by establishing allocations;
3. authorize temporary and permanent transfers of extraction allocations; and
4. establish rules to allow unused extraction allocations to be carried over from one year to another and voluntarily transferred.

However, SGMA acknowledges limitations on the regulation of pumping. Local agencies are not authorized to make a binding determination of the water rights of any person or entity (Water Code §§ 10720.5(b) and 10726.8(b)). Also, any actions to control extractions generally must be consistent with the city or county general plans (Water Code §§ 10726.4, 10726.8(f), and 10726.9).

Research into the use of similar authorities in other jurisdictions indicates that few agencies regulate pumping, and highlights related challenges. Where used, pumping regulation has been in response to significant basin problems like long-term overdraft or salt water intrusion, most commonly through the well permitting process. These agencies have struggled with well owner concerns, enforcement, and legal challenges. Others have decided against regulation due to concerns with water rights and the potential to trigger adjudication, focusing instead on financial incentives or groundwater replenishment.

GUIDING PRINCIPLES

The District's existing groundwater management framework has maintained sustainable groundwater conditions over many decades. This proven framework, including strong collaboration with stakeholders, is the preferred approach to address future challenges. However, SGMA authorities are available as potential tools if the need arises. The process to regulate groundwater extraction, if needed, is based on these guiding District principles:

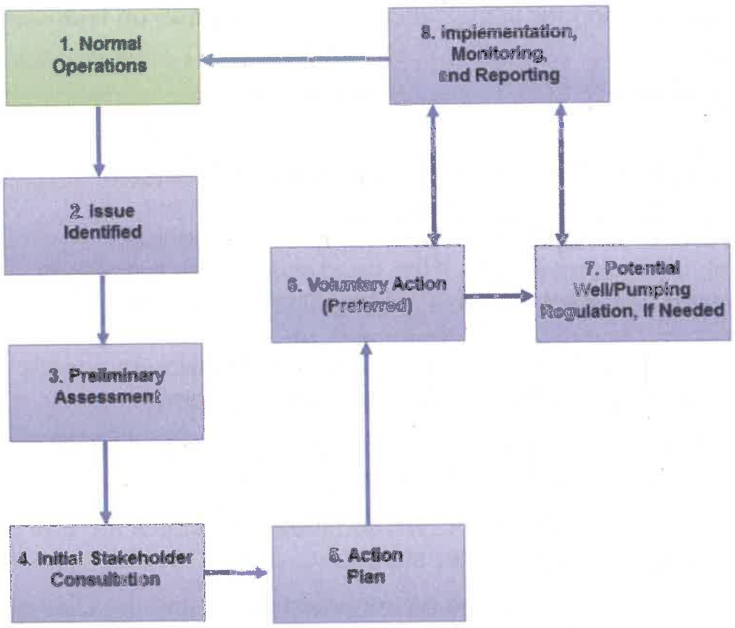
1. The District will sustainably manage local groundwater as part of our mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy.
2. The District will continue to conduct comprehensive water supply planning and invest in diverse water supplies to ensure reliability and avoid chronic shortages.
3. Through ongoing water supply operations, the District will continue to optimize the use of available water supplies while protecting groundwater storage.
4. Transparency in fulfilling the District mission remains an important driver and the District will continue to encourage input and participation from all interested stakeholders.

5. The District will continue to seek solutions that effectively and efficiently address identified water supply issues as they arise.
6. The District will work with water retailers and other stakeholders to continue to improve our understanding and management of groundwater basins and conditions, including sustainable use.
7. Strong partnerships with water retailers and other large groundwater users have been effective in avoiding undesirable results and are critical to future sustainability.
8. Collaboration with groundwater users and interested stakeholders will continue to be the preferred approach to address observed or projected undesirable results, and District regulation of pumping will only be considered if there is no viable alternative.
9. Given the uncertainty in the timing, location, and severity of potential future undesirable results, the process to regulate groundwater extraction avoids prescriptive triggers and requirements; instead, it clarifies how to respond to worsening conditions. This will maintain maximum flexibility to respond to changing conditions and avoid unnecessary or ineffective actions.

PROCESS TO REGULATE GROUNDWATER EXTRACTION, IF NEEDED

The existing groundwater management framework is expected to support continued, sustainable conditions, and pumping regulation may never be needed. The process described below and summarized in Figure 1 describes the fundamental approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction. As mentioned above, the focus is on providing certainty as to the process, while avoiding prescriptive requirements that may not be appropriate. This process allows for moving between the various steps linearly or using feedback loops.

Figure 1. Process to Regulate Groundwater Extraction, if Needed



1. Evaluate groundwater conditions, coordinate with water retailers, and receive stakeholder input
2. Identify new regulatory requirement or observed/projected undesirable result
3. Prepare memo describing issue and potential mitigation (e.g., additional supplies and/or demand reduction)
4. Meet with affected pumpers and/or other stakeholders to discuss issue and preliminary assessment
5. Develop draft action plan with stakeholder input, including desired outcome, roles, actions, schedule, monitoring, and reporting
6. Agree to implement voluntary actions to address issue (preferred)
7. Develop Board ordinance to implement SGMA authorities through Committee and public process
8. Implement voluntary and/or mandatory actions described in action plan and/or ordinance, monitor and report out to Board and stakeholders

Note: Depending on the severity and challenges of the issue identified, the implementation of any step could be elevated to the Committee and/or Board.

Step 1: Normal Operations

Comprehensive planning through the District's Urban Water Management Plan and Water Supply Master Plan ensures long-term water supply reliability (including groundwater) in accordance with level of service targets. Development of these plans includes coordination with water retailers and land use agencies, and the District encourages input from interested stakeholders. This regular, proactive planning avoids chronic shortages.

Operations planning helps meet near-term demands, protect groundwater reserves, and ensure adequate carryover supplies. Through this ongoing process, District staff develops operations scenarios based on the availability of imported and local supplies, including their optimal use and distribution. Water supply conditions are discussed with water retailers at least quarterly through Water Retailers Committee and Groundwater Subcommittee meetings, but operational or water supply issues often require more frequent communication and coordination. Current water supply information is also communicated to interested stakeholders through monthly Water Tracker updates and Groundwater Condition Reports, and the availability of groundwater level and other water supply data at www.valleywater.org.

Receiving input on groundwater management issues from interested stakeholders is an important part of normal operations. Accordingly, the District maintains a list of interested parties that includes water retailers, land use agencies, regulatory agencies, adjacent GSAs, non-governmental organizations, community groups, agricultural users, and private individuals, among others. The District notifies these interested parties of upcoming groundwater-related Board and Committee items and relevant information such as completion of the Annual Groundwater Report. The District also provides updates to all well owners on general topics of interest through regular mailings.

The District will continue to explore ways to ensure interested stakeholders are aware of groundwater management activities and opportunities for engagement, including participation in public meetings, Board correspondence, Access Valley Water inquiries, or direct communication with staff. The District evaluates all input and inquiries to determine if additional action is needed to protect groundwater resources.

Step 2: Issue Identified

Through the ongoing assessment of groundwater conditions described above, an issue requiring further action may be identified. This could be a new regulatory requirement, such as the need to limit water supply well construction near an indirect potable reuse project, or an observed or projected undesirable result as defined in Water Code §10721 and listed above. The GWMP identifies numeric outcome measures related to groundwater conditions that indicate the need for action; observed or projected failure to meet one of the outcome measures could lead to an undesirable result. There may also be unanticipated situations that do not trigger failure of an outcome measure, but require action to protect groundwater resources. If an issue requiring further action is identified, the District will inform potentially affected stakeholders and immediately move to the next step in the process.

Step 3: Preliminary Assessment

Once an issue requiring further action has been identified, District staff will use available information to evaluate the issue and summarize the findings in a technical memorandum. The memorandum will describe the nature and extent of impacts, suspected cause(s), potential

effects of taking no action, and potential mitigation options. These options may include District action, such as more focused monitoring, recommended shortage response per the Water Shortage Contingency Plan, efforts to acquire supplemental supplies, or incentives for the use of treated water. Mitigation options could also include the reduction of pumping within the impacted area.

Step 4: Initial Stakeholder Consultation

After completing the prior step, District staff will meet with selected stakeholders within the affected area to discuss groundwater conditions and the preliminary assessment. This initial consultation targets those likely needing to take action to help address the issue. In most cases this is expected to include higher-volume pumpers like water retailers that more strongly influence basin conditions. Depending on the nature of the issue, other affected stakeholders may also be consulted during this stage.

The District will work with stakeholders to evaluate additional data and update the preliminary assessment as necessary. The District and affected stakeholders will identify the schedule to develop an action plan as well as related roles and responsibilities.

It should be noted that this consultation may result in quick consensus on the need to act and what needs to be done. This occurred in 2014 when the District met with staff from the San Jose Water Company and the City of Santa Clara to discuss concerns with groundwater levels approaching subsidence thresholds within their service areas. In that case, a single meeting led to quick agreement on the need to voluntarily adjust pumping. This process is intended to support similar decisive action at the staff level when possible.

Step 5: Action Plan

Based on the timeline and roles identified during the initial stakeholder consultation, District staff and/or affected stakeholders will develop a draft action plan to address the issue. This action plan will identify the desired outcome and clearly define actions needed, roles and responsibilities, implementation schedule, and how the issue will be monitored. The action plan will also explain the mechanism and timing of status reports to the Board and interested stakeholders. If the proposed mitigation involves pumping curtailment, staff recommends that affected pumpers have the first opportunity to propose an action plan to meet the desired outcome.

In the 2014 example mentioned above, District and retailer staff collaborated quickly and effectively to reduce localized pumping and minimize the risk of subsidence. Similarly, it is expected that some issues can be effectively resolved at the staff level, with ongoing reporting to the Board Committee and stakeholders as appropriate. However, effective action plans for more severe, challenging, or widespread issues may need to be elevated to allow for more extensive input. In these cases, it may be appropriate to develop the action plan in consultation with all potentially interested stakeholders through the open forum of the Board Committee.

Step 6: Voluntary Action (Preferred Option)

Staff, affected pumpers, and other interested stakeholders will work to finalize an action plan that is likely to be effective in addressing the identified issue. This is the preferred option, which avoids resorting to the need to potentially regulate pumping under SGMA authorities. If

agreement for voluntary action is reached, all entities responsible for implementing the action plan will need to concur with the action plan prior to implementation.

Step 7: Potential Well/Pumping Regulation, if Needed

The District and affected pumpers may not reach consensus on a voluntary action plan or implementation of a voluntary action plan may not prove effective in addressing the identified issue. In those cases, the District may need to consider implementing any of the authorities provided by SGMA under the following process:

1. Discuss groundwater conditions and the potential need for pumping regulation at the Water Conservation and Demand Management Committee and receive input from the Committee and stakeholders;
2. Implement action recommended by the Committee, which may include, but not be limited to, discussion with the full Board, further District action, or additional attempts to reach consensus on voluntary action;
3. Prepare a draft ordinance to regulate groundwater extraction in accordance with Water Code §10726.4 or otherwise exercise authorities provided by SGMA; and
4. Conduct a public hearing for Board consideration of the proposed ordinance.

Step 8: Implementation, Monitoring, and Reporting

The District, affected pumpers, and other identified stakeholders will implement the voluntary and/or mandatory actions described in the action plan and/or ordinance. District staff will monitor the status of action commitments, groundwater conditions, and performance in meeting the desired outcome. Related reporting to the Committee and/or Board as well as interested stakeholders will be in accordance with the action plan or ordinance. Based on the monitoring results and progress toward meeting the desired outcome, operations may return to normal or the voluntary/mandatory action may need to be modified. Successful execution of this step will require close tracking/monitoring and good communication.

TIME FRAME FOR IMPLEMENTATION OF THE PROCESS

There are no fixed time frames assigned to each step above due to the wide range of possibilities in terms of potential issues and related action needed, including whether it is voluntary or mandated. Staff anticipates that, for more manageable issues, effective voluntary action could be implemented within six months. More severe or widespread issues may take longer to address, even through voluntary action, as they may require consideration by a city council, board, or regulatory agency, or due to implementation lead time.

It is expected that if pumping regulation became necessary, implementation of the process listed under Step 7 would take several months to provide adequate noticing and opportunity for input. This time frame should be considered to correspond to the most extreme and severe conditions, with more time likely needed to fully engage potentially affected pumpers and interested stakeholders on this complex and controversial issue.

The severity of the issue will correspond to the response, with more resources and urgency allocated to more extreme issues. In any case, the District will work to expedite an effective response to minimize the risks to beneficial users or groundwater resources, and will remain committed to prioritizing voluntary collaboration over regulation whenever possible.

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Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed

February 27, 2018

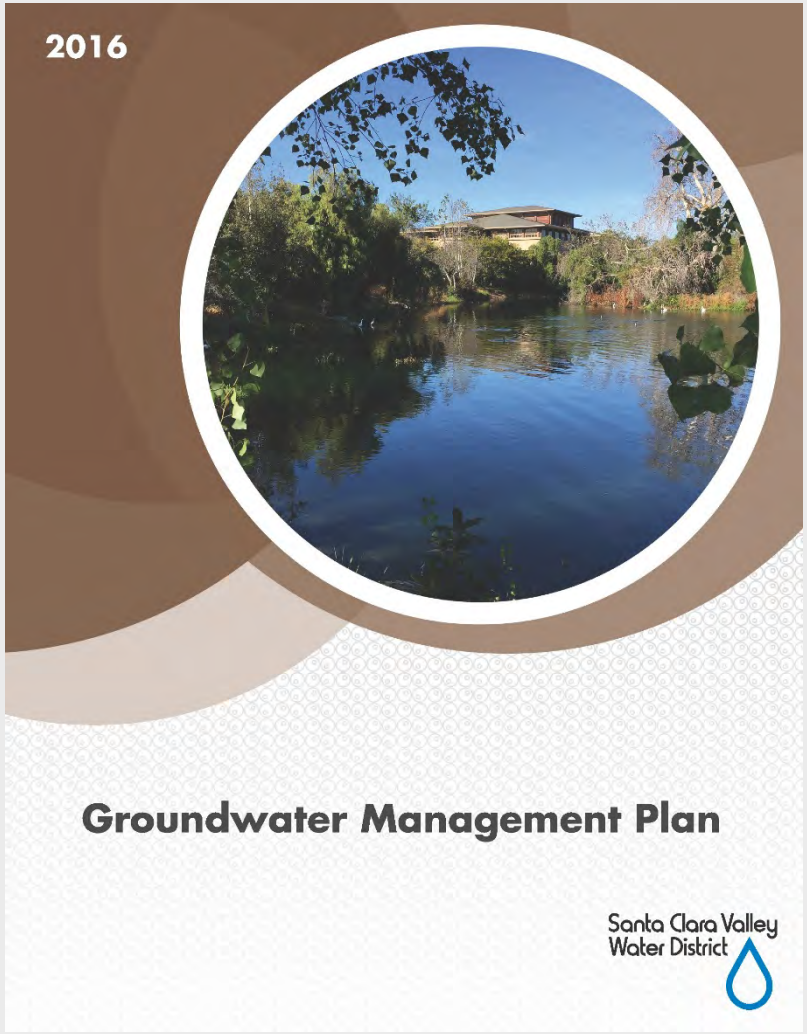
Santa Clara Valley Water District

Groundwater management authority

- Broad District Act authority has supported sustainable groundwater management for many decades
- Sustainable Groundwater Management Act (SGMA) provides additional tools that may be needed in the future
  - Groundwater well/ extraction regulation
  - Different fee types

Groundwater Management Plan

- 2016 Groundwater Management Plan developed for SGMA compliance
- Retailer concerns over potential pumping regulation
- Stakeholder engagement referred to Board's Water Conservation and Demand Management Committee (Committee)



Evaluation of new SGMA authorities

- Nine publicly-noticed Committee meetings to discuss new SGMA authorities
- Committee received input from water retailers and other stakeholders, resulting in
  - Exploration of fixed charges as groundwater production charge component
  - Process to regulate groundwater extraction, if needed

Goals of process

- Affirm guiding principles supporting continued sustainable conditions
- Clarify process to respond to worsening basin conditions
- Identify steps that would be taken prior to regulating pumping
- Avoid prescriptive requirements that might lead to ineffective or unnecessary action

Process to Regulate Pumping, if Needed

1. Normal Operations

Evaluate GW conditions, coordinate with retailers, and receive stakeholder input

2. Issue Identified

Identify projected/observed undesirable result or regulatory requirement

3. Preliminary Assessment

Prepare memo describing issue and potential mitigation

4. Initial Stakeholder Consultation

Meet with affected pumpers and/or other stakeholders to discuss preliminary assessment

5. Action Plan

With stakeholder input, identify desired outcome, roles, actions, schedule, monitoring, and reporting

6. Voluntary Action (Preferred)

Agree to implement voluntary actions to address issue

7. Potential Well/Pumping Regulation

Develop Board ordinance to implement SGMA authorities through Committee and public process

8. Implementation, Monitoring, and Reporting

Implement voluntary and/or mandatory actions and report out to Board and stakeholders

Note: Depending on the severity and challenges of the issue identified, the implementation of any step could be elevated to the Committee and/or Board.

Recommendation

- Adopt the resolution Memorializing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed

Handout 5.1-A
02/27/18

Michele King

From: Jack Lucas <jlucas1099@aol.com>
Sent: Tuesday, February 27, 2018 12:44 PM
To: Board of Directors
Subject: Groundwater Management Resolution SCVWD Board - February 27, 2018

Director Richard Santos, Chair
Santa Clara Valley Water District Board of Directors

February 27, 2018

Dear Director Richard Santos,

In regards today's Board Agenda resolution regarding process to regulate groundwater extraction in accordance with the Sustainable Groundwater Management Act (SGMA), do believe this is a critical and commendable action for the Board to take at this time.

Would urge Board to extend its conservation resolutions even further to encompass watershed protection for all tributary streams which supply your Santa Clara Valley groundwater basin.

Specially along western foothills of Santa Clara Valley fourteen streams supply high quality water to deep drinking water aquifers across a fold in topography known as the groundwater cascade. This geological percolation arc is rather unique to our valley and requires respect and protection. Equivalent percolation is difficult to duplicate with engineered filtration galleries or injection wells.

Conservation criteria could necessarily reflect California Water Law as to riparian, appropriative and prescriptive rights, stream diversions and well permit applications, but it could detail priorities in beneficial and domestic uses, and differentiate between agricultural and horticultural irrigation.

My personal concern has been use of Adobe, Los Trancos and San Francisquito Creeks for college campus irrigation to detriment of downstream riparian corridors when drought tolerant vegetation would provide natural, attractive and economical options.

District's public education efforts have been good but believe they must go farther and faster, if global warming trends continue to send us such erratic swings in temperature and precipitation.
Please inspire public to appreciate prime resources that valley enjoys and do engage scientists.

Thank you,

Libby Lucas

PS Might suggest it is imperative to educate engineers, upgrading South Bay infrastructure, as to ecology and environmental constraints of percolation streams relative to critical basin aquifer. I worry about High Speed Rail impacts to groundwater cascade if routed through Metcalf Narrows. Cal Trans cementing in of percolation reach of Regnart Creek under #85 is case in point.

REFER TO STAFF

FEB 27 2018

APPENDIX G

TECHNICAL MEMORANDUM

IDENTIFICATION OF GROUNDWATER DEPENDENT ECOSYSTEMS (GDEs) FOR THE 2021 GROUNDWATER MANAGEMENT PLAN

Prepared by:

Randy Behrens, P.G.

Assistant Water Resources Specialist

and

Jason Gurdak, Ph.D., P.H.

Senior Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.

Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

October 2021

Executive Summary

This technical memorandum documents the development of a new geographic information system (GIS) based map of groundwater dependent ecosystems (GDEs) in the Santa Clara and Llagas subbasins that will be included in the 2021 Groundwater Management Plan (GWMP) update. The identification of GDEs is one of five recommended actions by Department of Water Resources (DWR) in their review of the 2016 GWMP, which is the Alternative to the Groundwater Sustainability Plan [Alternative] that was approved by DWR in 2019. The purpose of this memorandum is to detail the understanding, approach, and methods used to identify and map GDEs in the Santa Clara and Llagas subbasins.

The final GDE maps are based on all California phreatophytes, as identified in local-scale vegetation and land cover maps, in areas of the subbasins with depth to water (DTW) less than 50 feet below land surface. Phreatophytes in areas with DTW greater than 50 feet were not categorized as GDEs because the DTW generally exceeds phreatophyte rooting depths and the phreatophytes are likely supported by surface water that is not hydraulically connected to groundwater in the subbasins. Most GDEs in the subbasins are along stream reaches and in known wetlands, such as the Laguna Seca area of northern Coyote Valley. Most of these stream reaches are losing reaches and are actively used in Valley Water's managed in-stream recharge operations. To verify the accuracy of the final GDE map, field assessments of vegetation were conducted at 34 targeted sites in the Santa Clara and Llagas subbasins. Over 90% of the assessments agreed with the mapped GDE designations, which indicates that the final GDE maps represent on-the-ground conditions well. Based on these results, the final GDE maps have a relatively high ability to accurately identify GDEs in the Santa Clara and Llagas subbasins. The final GDE maps and major findings from this memorandum will be summarized in the 2021 GWMP update.

1. Introduction

The Sustainable Groundwater Management Act (SGMA) was signed into law by Governor Jerry Brown in 2014 and provides a statewide framework for the sustainable management of groundwater in California. SGMA defines sustainable groundwater as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results. SGMA empowers local agencies to form Groundwater Sustainability Agencies (GSAs) to manage basins sustainability and requires those GSAs to adapt Groundwater Sustainability Plans (GSPs).

As the GSA for the Santa Clara and Llagas subbasins, Valley Water submitted the 2016 Groundwater Management Plan (GWMP) as an Alternative to the Groundwater Sustainability Plan (GSP) [Alternative] prior to the statutory deadline of January 1, 2017. Water Code Section 10733.6(b) allows for several different types of Alternatives, including plans developed pursuant to other laws authorizing groundwater management, such as the Santa Clara Valley Water District Act. On July 17, 2019, DWR approved the Alternative for both the Santa Clara and Llagas Subbasins. In their cover letters for approval, DWR noted that the Alternative Assessment Staff Report "…proposed recommended actions for the consideration of the Santa Clara Valley Water District that the Department believes will enhance the Alternative and facilitate future evaluation by the Department. The recommended actions do not constitute a qualified approval of the Alternative; however, the Department encourages they be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates.".

DWR's five recommended actions covered topics about groundwater dependent ecosystems (GDEs), climate change, water quality outcome measures, and clarifying other outcome measures. DWR's specific recommended action regarding GDEs is as follows:

> "Staff recommend that the District [Valley Water] provide an identification of groundwater dependent ecosystems in the Subbasin."

Therefore, this memo documents Valley Water's response to this DWR recommended action, including the approach, methods, and results that were used to identify GDEs in the Santa Clara and Llagas subbasins. Major findings from this memo will be summarized in the 2021 GWMP update. This detailed technical memo and information in the 2021 GWMP describe Valley Water's groundwater management practices to maintain sustainable groundwater conditions that help support GDEs, which are part of the larger ecosystem within the Santa Clara County.

1.1. SGMA and GDEs

SGMA has requirements to identify and consider the impacts to GDEs. SGMA defines GDEs as "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351(m)). GDEs in California include a wide range of natural communities, including wetlands, rivers, streams, and estuaries, seeps and springs, and terrestrial vegetation. GDEs also include deep-rooted plants or plant communities that obtain water from the water table (called phreatophytes). Chronic lowering of groundwater levels or depletion of interconnected surface water by groundwater development or climate change can negatively affect GDEs (Klove et al., 2014). Negative impacts on GDEs are problematic for society because GDEs provide a range of ecosystem services, including water purification, soil preservation, flood risk reduction, carbon sequestration, and recreation (Rohde et al, 2018).

SGMA requires that GSAs shall broadly consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing GSPs (Water Code § 10723.2). These interests include but are not limited to holders of overlying groundwater rights (agricultural users and domestic well owners), municipal well operators, public water systems, local land use planning agencies, environmental uses of groundwater, surface water users, if there is a hydrologic connection between surface and groundwater bodies, federal government, California Native American tribes, and disadvantaged communities. GDEs are included in these interests because of their environmental use of groundwater and use of surface water if connected with groundwater.

More specifically under SGMA, the GSP regulations (23 CCR § 354.16) require a description of historical and current groundwater conditions in the basin that includes information related to groundwater elevations, groundwater storage, seawater intrusion, groundwater quality, subsidence, and interconnected surface water, as applicable. The GSP regulations also require an identification of GDEs under these groundwater conditions. GSP regulations (23 CCR § 354.16(g)) require the "identification of GDEs within the basin, utilizing data available from the Department, as specified in Section § 353.2, of the best available information."[1] Section § 353.2 describes information provided by the Department, including section § 353.2(b) that states "The Department shall provide information, to the extent available, to assist Agencies [GSAs] in the preparation and implementation of Plans, which shall be posted on the Department's website."

DWR has many guidance documents posted on their website, but none are specifically about GDEs or identifying GDEs. However, The Nature Conservancy (TNC) has created the Groundwater Resources Hub (https://groundwaterresourcehub.org/) that hosts many resources to assist GSAs, including guidance

[1] Alternatives to GSPs, such as the 2021 GWMP, are not subject to the specific requirements for GSPs, but must demonstrate functional equivalency.

documents about GDEs. Specifically, the Groundwater Resources Hub has a guidance document called "Groundwater dependent ecosystems under the Sustainable Groundwater Management Act – Guidance for preparing Groundwater Sustainability Plans" (Rohde et al., 2018). While Rohde et al. (2018) is not a DWR-authored guidance document, both DWR and the State Water Resources Control Board were acknowledged for their contribution and review. As described below, this TNC GDE guidance document was generally followed as an approach to identify GDEs in the Santa Clara and Llagas subbasins.

1.2. Conceptual Model of GDEs in the Santa Clara and Llagas Subbasins

The following conceptual model guided the approach to identify GDEs in the Santa Clara and Llagas subbasin. Prior to development of the Santa Clara Valley, numerous areas were known to have areas of shallow groundwater near land surface, marsh-like conditions, and well-developed wetland vegetation indicative of GDEs (Grossinger et al., 2006; Beller et al., 2010). Even today, despite significant drainage pattern alterations and agriculture and urban development, shallow groundwater conditions persist in some areas that likely support GDEs. Flows in gaining stream reaches are supported by shallow groundwater discharge (Figure 1A), including the riparian vegetation and associated GDEs. Low lying areas near sea level along the San Francisco Bay are also locations of natural groundwater discharge that may support GDEs. However, most stream reaches in the recharge (unconfined) areas of the Santa Clara and Llagas subbasins are either losing streams that are connected to the water table (Figure 1B) or losing streams that are disconnected from the water table (Figure 1C) and both are an important component of Valley Water's managed recharge program. The riparian vegetation along losing or disconnected streams may be indicative of GDEs if the roots are deep enough to reach the water table, as described in more detail below. Some of Valley Water's managed recharge activities along losing and disconnected streams, including imported water and reservoir releases have created streamflow conditions that now support riparian vegetation where they may not have otherwise occurred without these water management activities.

1.3. Summary of GDE Identification in the 2016 GWMP

The 2016 GWMP did not specifically identify GDEs but did summarize several other datasets that could be used to help identify GDEs, including surface-water/groundwater interactions, historical ecology maps, and depth to shallow groundwater.

The 2016 GWMP summarized the subbasin areas with known and suspected surface-water/groundwater interactions (Figure 2) in addition to instream groundwater recharge locations. Figure 2 was based on long-term observations by Valley Water staff and supported by a 2018 differential gauging study conducted by Valley Water staff. This differential gauging study compared stream discharge at upstream and downstream gauges during the low flow period of April to July 2018. Downstream gauges with an increase in stream discharge compared to the upstream gauge indicate the reach is in a groundwater discharge area and a gaining stream. Conversely, downstream gauges with a decrease in stream discharge compared to the upstream gauge indicate the reach is in a groundwater recharge area and a losing stream. Figure 2 was used to help identify sections of gaining streams and suspected locations of groundwater discharge. Most of the gaining sections overly the confined part of the aquifer, with a few notable exceptions (Figure 2). The 2016 GWMP notes that Valley Water's managed recharge program relies on losing stream reaches, where the groundwater and surface water are disconnected. However, the 2016 GWMP further states that some areas are not necessarily net losing reaches and some reaches may be intermittently gaining during the wet season.

Figure 1. Groundwater and Surface-Water Interactions – (A) Gaining, (B) Losing, and (C) Disconnected Streams (Modified from Winter et al., 1999).

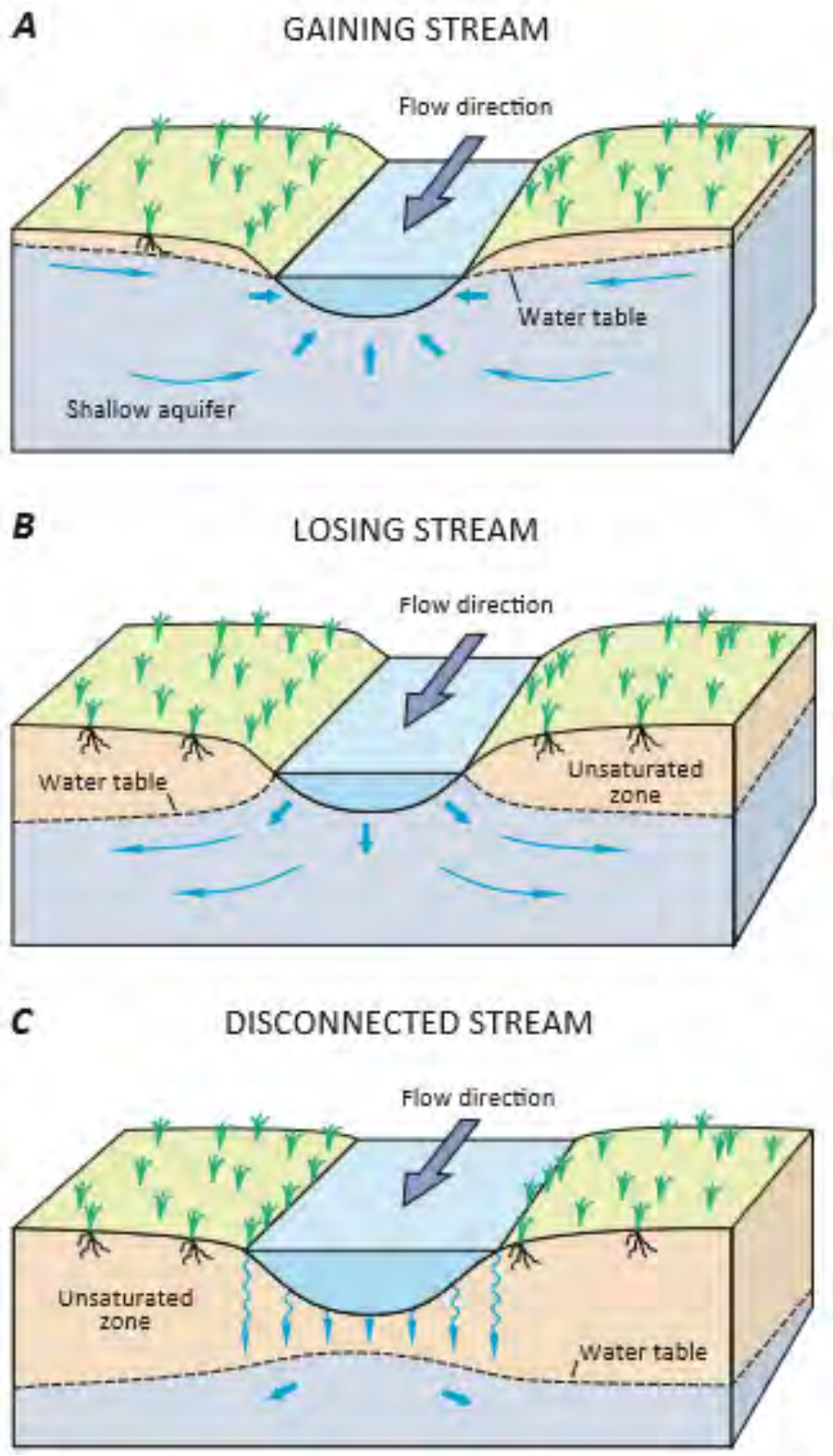
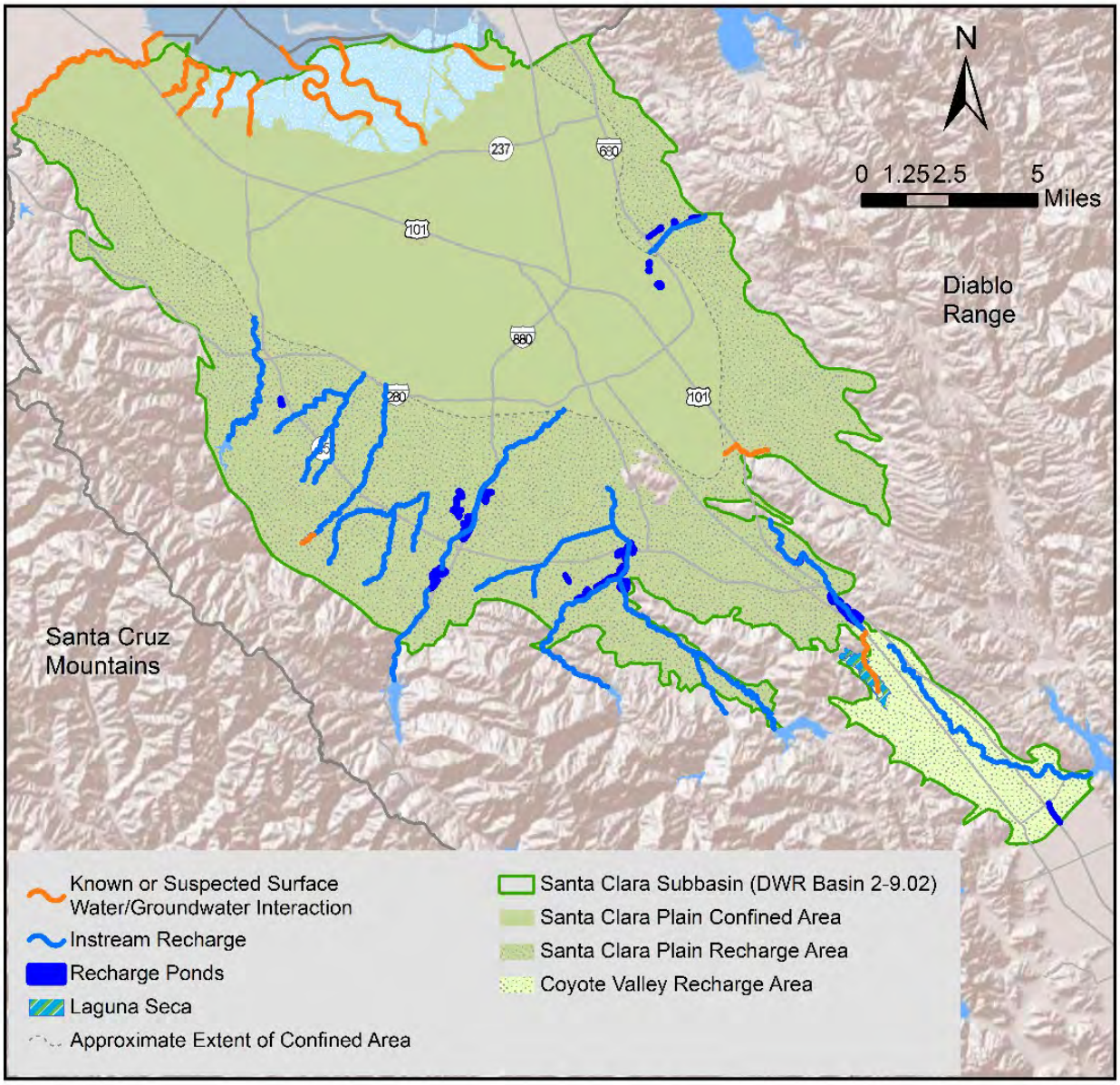


Figure 2. Known and Suspected Surface-Water/Groundwater Interactions (from Figure 2-14 in the 2016 GWMP).



In addition to the known and suspected locations of gaining streams (Figure 2), the 2016 GWMP presented a map of historical ecology that was developed by the San Francisco Estuary Institute (SFEI) (Figures 3 and 4). Figures 3 and 4 show the locations of historical (circa early 1800s) wetlands and other ecological communities that may be associated with shallow groundwater and characterized as historical locations of GDEs. The 2016 GWMP acknowledges that these maps do not represent current or recent conditions throughout much of the Santa Clara Valley.

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Figure 3. Santa Clara Subbasin Historical Ecology from the early 1800s (from Figure 2-15 in the 2016 GWMP).

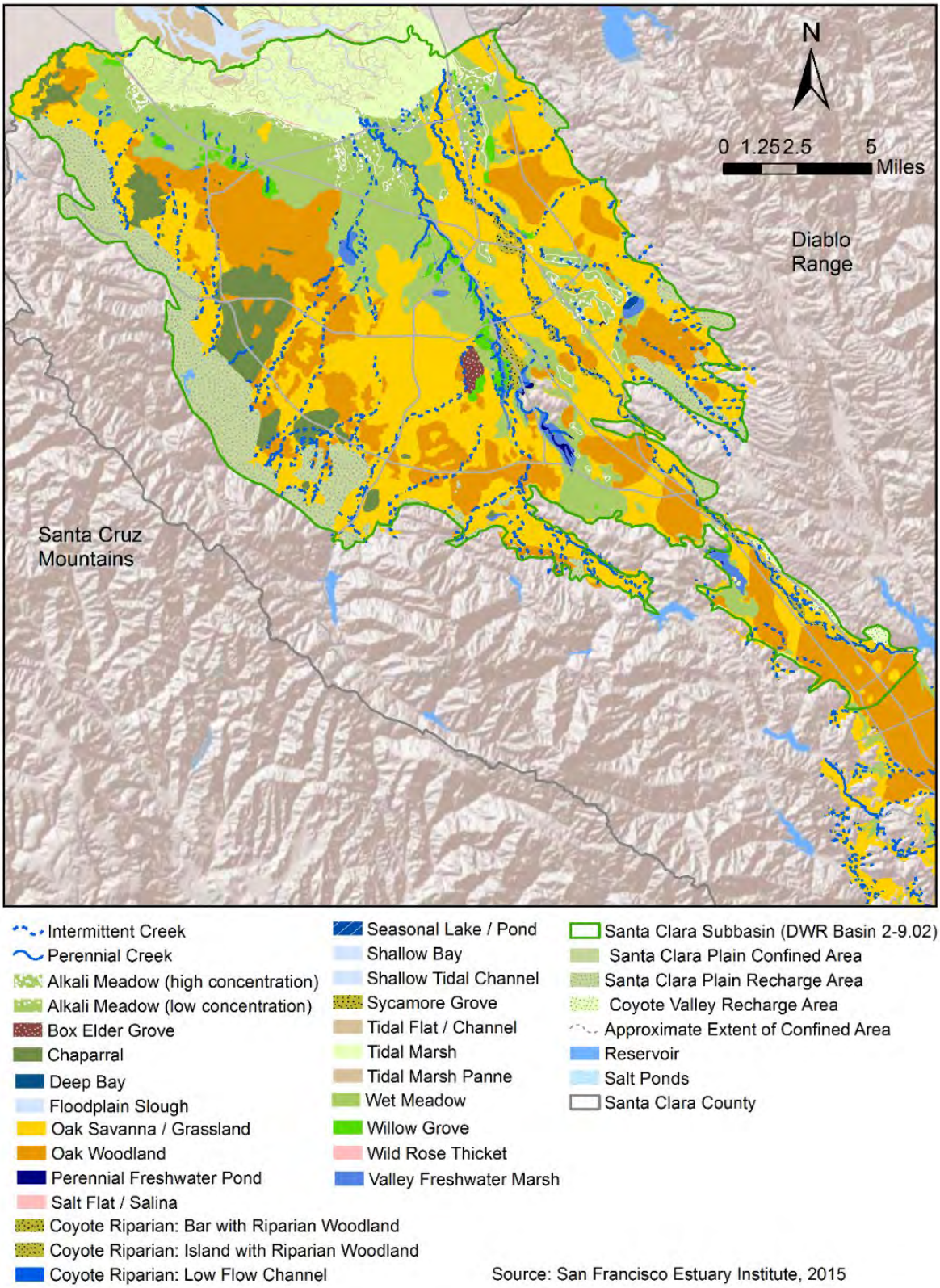
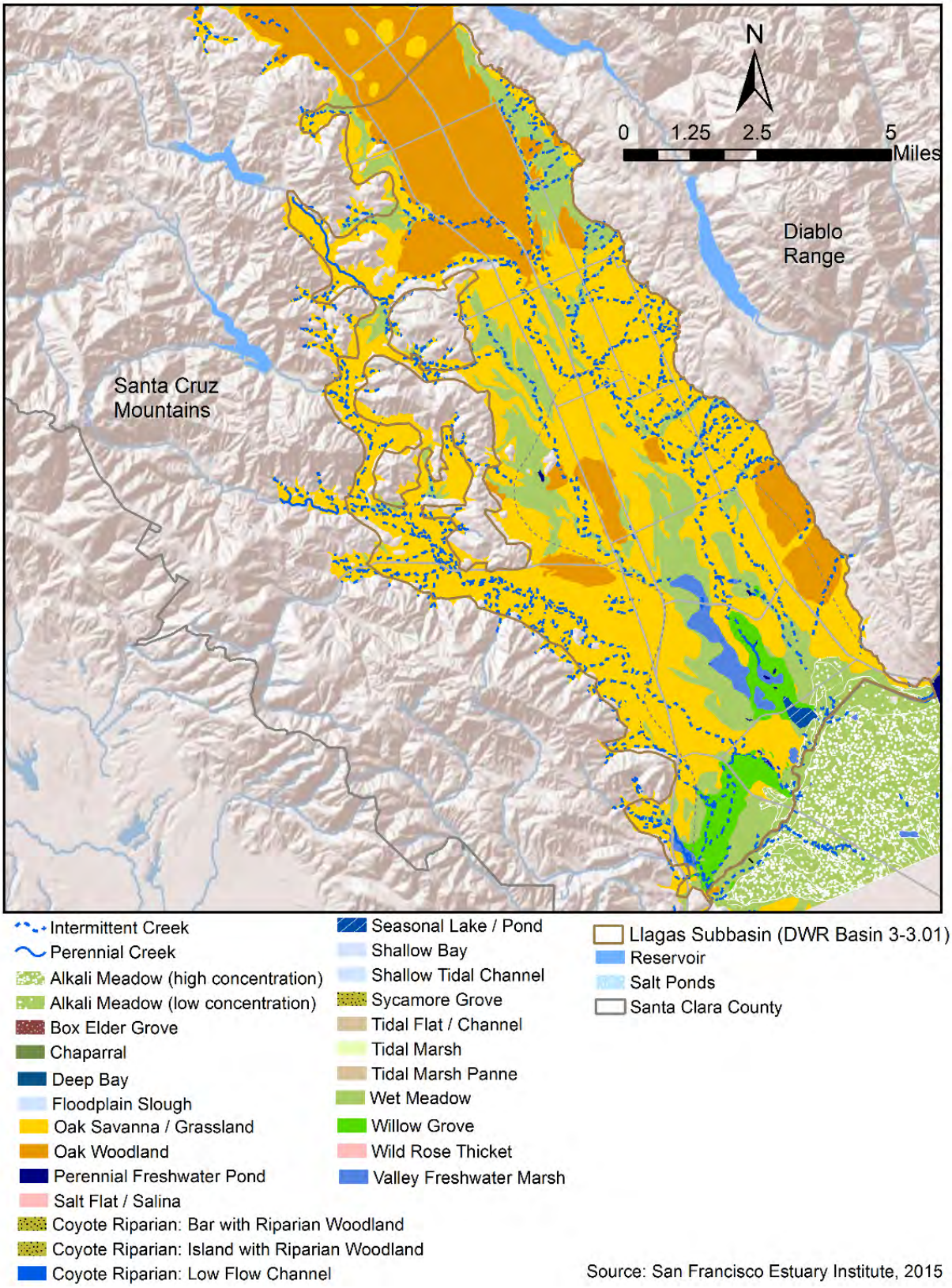


Figure 4. Llagas Subbasin Historical Ecology from the early 1800s (from Figure 3-11 in the 2016 GWMP).



The 2016 GWMP also presented maps of depth to first groundwater in the Santa Clara (Figure 5) and Llagas (Figure 6) subbasins. Figures 5 and 6 were based largely on shallow water encountered at leaking underground storage tanks sites as of 2003. While these maps show general patterns of depth to first water, the resolution is too coarse to help identify smaller scale GDEs, such as along stream reaches.

Figure 5. Depth to First Groundwater in the Santa Clara Subbasin (from Figure 2-16 in the 2016 GWMP).

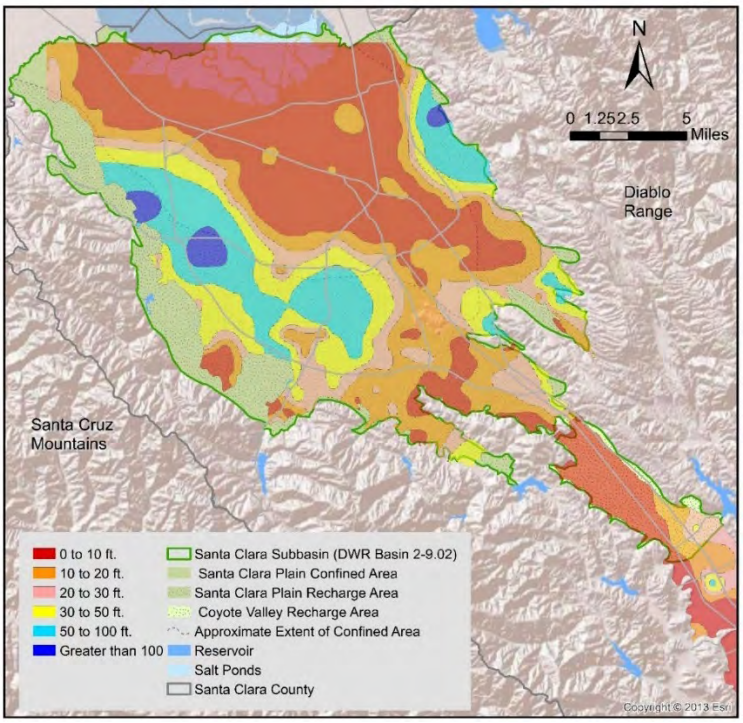
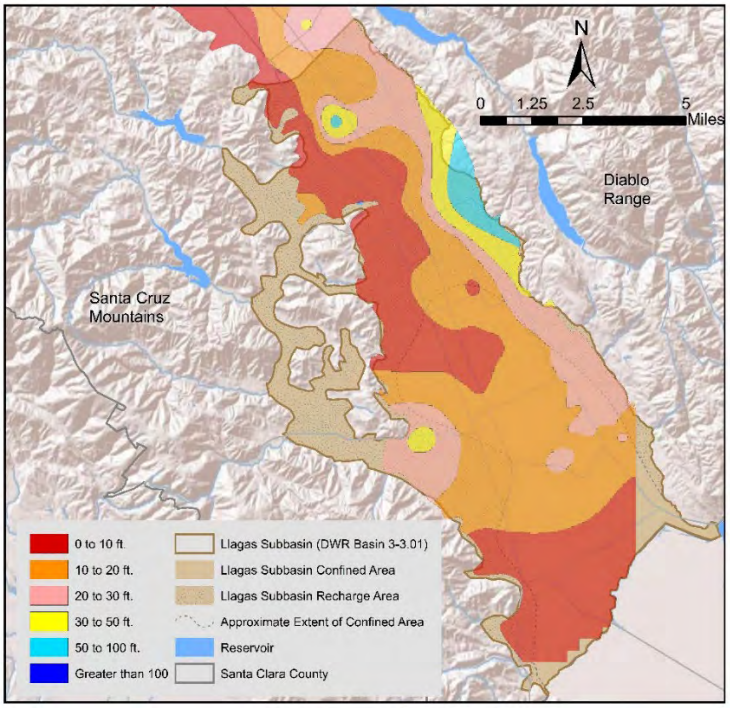


Figure 6. Depth to First Groundwater in the Llagas Subbasin (from Figure 3-12 in the 2016 GWMP).



1.4. Purpose and Scope

The purpose of this memo is to describe the current understanding, approach, and methods used to identify and map GDEs in the Santa Clara and Llagas subbasins. The memo presents the results of 34 field assessments performed by Valley Water biologists and describes how those results were extrapolated and used in conjunction with a detailed map of depth to water (DTW) to delineate GDEs. The GDE maps presented here will be revised and updated as new information becomes available during each five-year GWMP update cycle. While this memo presents the technical details of GDE identification and mapping, major findings and the GDE maps will be summarized in the 2021 GWMP update. For completeness of methods, we describe the use of a few routines within the widely used GIS software ArcMap, developed by ESRI, Redlands CA. Details about the GIS routines are omitted here because there is an abundance of ArcMap online documentation.

2. Approach and Methods

The GDE maps were developed by generally following the approach detailed in The Nature Conservancy (TNC) guidance document on GDEs and preparing GSPs (Rohde et al., 2018). As recommended in Rohde et al. (2018), Valley Water used local-scale vegetation and land cover maps rather than relying on the statewide iGDE map ('Natural Communities' map). The local-scale vegetation and land cover maps used provide greater accuracy, leverage prior investments, and may provide some consistency for other water management purposes.

To complement the local-scale vegetation and land cover maps and to ensure accurate identification of GDEs, Valley Water also created a basin-wide and detailed DTW map using a combination of existing state online data resources, Valley Water's water level monitoring data, and well installation and permitting records. Finally, 34 sites were selected for field assessment by Valley Water biologists to determine the presence of GDE conditions, including the preponderance of phreatophyte vegetation, hydric soil, and other indicators of GDEs. The remainder of this section describes in detail the various data sources, data processing methods, and GDE identification methods.

2.1. GIS Data of Vegetation and Land Cover

Two GIS data sources were used for the preliminary identification of the GDEs: (i) the Santa Clara Valley Habitat Agency [Habitat Agency] 'Land Cover' map, and (ii) the 'AIS Stream Vegetation' layer that is a Valley Water GIS dataset. The Habitat Agency (2020) 'Land Cover' dataset[2] is particularly useful for GDE mapping because it describes the various vegetation types and other land cover categories in most of Santa Clara County, although it does not provide complete coverage of the Santa Clara Subbasin. The 'AIS Stream Vegetation' GIS dataset was created by AIS Consulting (2010) and is a map of vegetation types along streams in Santa Clara County up to 1,000 feet in elevation, which provides good coverage for the Santa Clara and Llagas subbasins. Since both the land cover and AIS stream vegetation data sets had desirable attributes for mapping GDEs, Valley Water merged the maps together into a single map that retains all the features from each individual map (Figure 7). The vegetation types in the merged map (Figure 7) were assigned as *California phreatophytes*, based on their dominant species, guidance from TNC (Rohde et al.,2018), and regional patterns, as listed in Table 1 and Table 2.

[2] Available at Santa Clara County Planning Office GIS Data page (Accessed August 23, 2021): https://gisdata2-sccplanning.opendata.arcgis.com/datasets/sccplanning::land-cover/about

Figure 7. Example of the Merged Map of the AIS Stream Vegetation and Habitat Agency Land Cover.

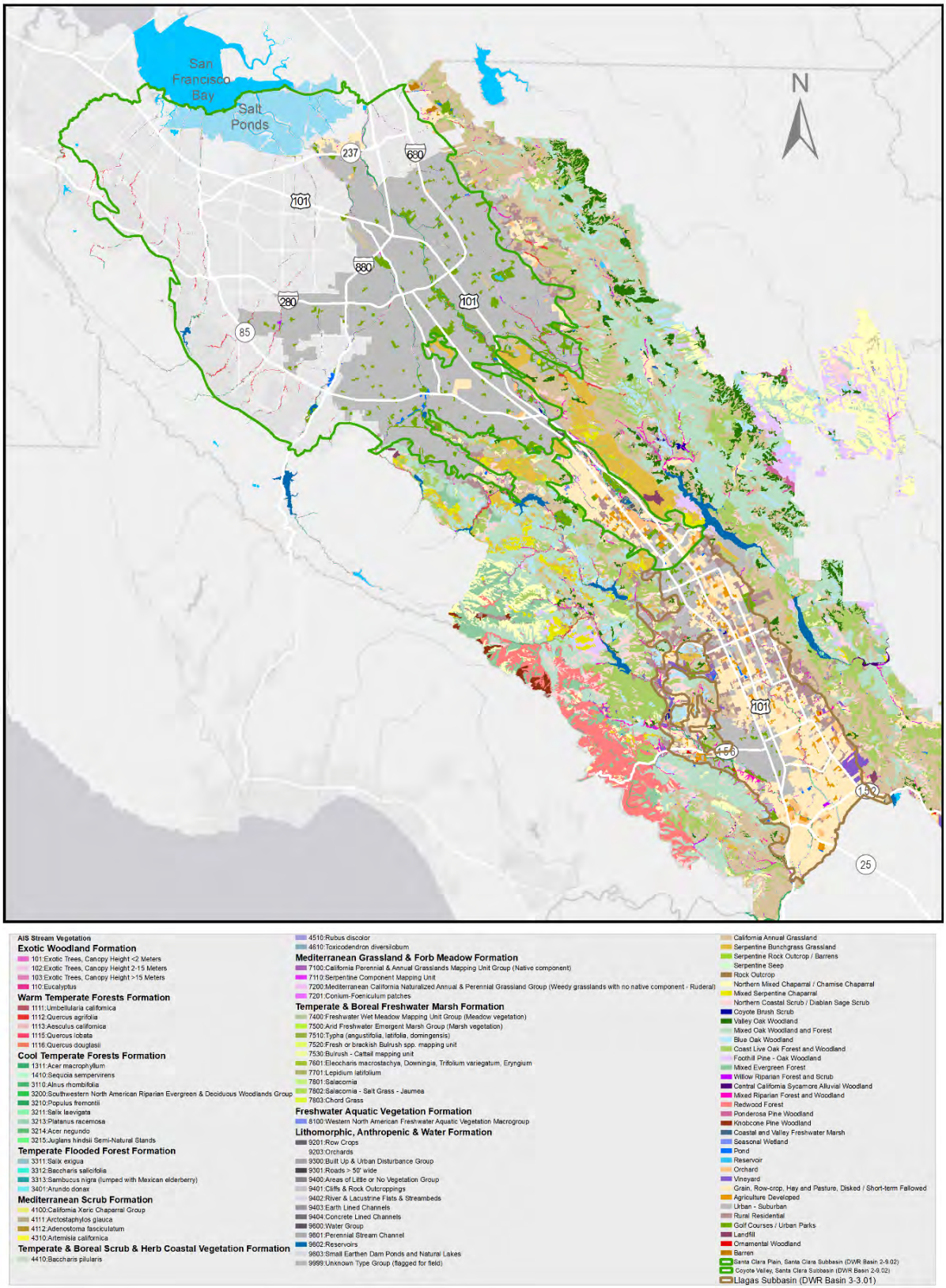


Table 1. California Phreatophyte Status of Valley Habitat Agency Land Cover Types.

Valley Habitat Plan Land Cover Type	California Phreatophyte (Yes or No)	Phreatophyte Status Notes[1]
Agriculture Developed	No	
Barren	No	
California Annual Grassland	No	
Coast Live Oak Forest and Woodland	Depends on location	Coast live oak is listed as a phreatophyte in California by TNC, and Steinberg (2002) says "Several deep main roots may tap groundwater if present within approximately 36 feet (11 m) of the soil surface. Coast live oak develops extensive horizontal root branches and surface-feeding roots." This species often grows near creeks, where it is likely groundwater dependent, but farther away it is not. It is not listed as a wetland indicator species by USACE (2018). As such, stands of this species alone should not be used to define GDEs unless in known shallow aquifer, near a waterway, and/or growing with other phreatophytes.
Coyote Brush Scrub	No	Listed by TNC[2]; not on wetland indicator list for CA; While Kidder PhD says "Dry season xylem waters for adult B. pilularis plotted near groundwater, indicating these plants likely relied on deeper water sources" many of our regional occurrences of this species do not indicate shallow groundwater and would likely be tolerant of groundwater table declines.
Golf Courses / Urban Parks	No	
Knobcone Pine Woodland	No	Not listed by TNC; no wetland indicator status; regionally this species is indicative of dry, well drained, upland areas.
Mixed Evergreen Forest	No	Depends on location. Mostly found on foothills or mountainous areas but in close proximity to creeks and streams. Also associated with Bay Laurel (FAC)[1], Big leaf maples (FAC), coast live oak.
Mixed Riparian Forest and Woodland	Yes	
Northern Coastal Scrub / Diablan Sage Scrub	No	Member species not listed by TNC; no wetland indicator status; regionally this vegetation type is indicative of very dry, well drained, upland conditions.
Orchard	No	
Pond	Depends on location	Characteristic species of pond margins and shallow ponds depend on surface water and shallow groundwater.
Redwood Forest	Depends on location	Sequoia is listed by TNC as CA phreatophyte and, where native, redwoods often grow near stream. Regionally, however, coast redwood is not considered native and is typically a planted/ornamental species that likely depends on irrigation.
Rock Outcrop	No	
Seasonal Wetland	Yes	Characteristic species use surface water and shallow groundwater.
Serpentine Rock Outcrop / Barrens	No	
Urban – Suburban	No	
Vineyard	No	
Northern Mixed Chaparral / Chamise Chaparral	No	Member species not listed by TNC; no wetland indicator status; regionally this vegetation type is indicative of very dry, well drained, upland conditions.
Mixed Serpentine Chaparral	No	Member species not listed by TNC; no wetland indicator status; regionally this vegetation type is indicative of very dry, well drained, upland conditions.
Mixed Oak Woodland and Forest	Depends on location	Coast live oak is listed as a CA phreatophyte by TNC, and US Forest Service says "Several deep main roots may tap groundwater if present within approximately 36 feet (11 m) of the soil surface. Coast live oak develops extensive horizontal root branches and surface-feeding roots." This species often grows near creeks, where it is likely groundwater dependent, but farther away it is not. It is not listed as a wetland indicator species by USACE. As such, stands of this species alone should not be used to define GDEs unless in known shallow aquifer, near a waterway, and/or growing with other phreatophytes.
Blue Oak Woodland	No	

Valley Habitat Plan Land Cover Type	California Phreatophyte (Yes or No)	Phreatophyte Status Notes[1]
Foothill Pine - Oak Woodland	No	
Valley Oak Woodland	Yes	Listed by TNC; wetland indicator status = FACU[1]; uses deep groundwater.
Ponderosa Pine Woodland	No	
Willow Riparian Forest and Scrub	Yes	
Coastal and Valley Freshwater Marsh	Yes	
Reservoir	No	
Grain, Row-crop, Hay and Pasture, Disked / Short-term Fallowed	No	
Ornamental Woodland	No	
Serpentine Seep	Yes	
Serpentine Bunchgrass Grassland	No	
Rural Residential	No	
Landfill	No	
Central California Sycamore Alluvial Woodland	Yes	

Notes:

1) United States Army Corps of Engineers (USACE) wetland plant indicator status categories used in some descriptions are as follows:
OBL = Obligate Wetland Plants: Plants that occur almost always (estimated probability >99%) in wetlands in natural conditions but may also occur rarely in (estimated probability <1%) in non-wetlands.
FACW = Facultative Wetlands Plants: Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands
FAC = Facultative Plants: Plants with similar likelihood (estimated probability of 33% to 67%) of occurring in wetlands and non-wetlands
FACU = Facultative Upland Plants: Plants that occur sometimes in wetlands (estimated probability 33% to 67%) but occur more often (estimated probability >67% to 99%) in non-wetlands
UPL = Obligate Upland Plants: Plants that occur rarely in wetlands (estimated probability <1%), but occur almost always (estimated probability >99) in non-wetlands under natural conditions

2) TNC = The Nature Conservancy

Table 2. AIS Vegetation Types.

AIS Vegetation Type	California Phreatophyte (Yes or No)	Phreatophyte Status Notes
Bigleaf maple	Depends on location	Not listed by TNC[2]; wetland indicator status = FAC[1]; often associated with creeks/creek canyons, but often on extremely steep, well-drained slopes.
Box elder	Yes	
Chamise	No	Listed by TNC; no wetland indicator status; regionally this species is indicative of very dry, well drained, upland conditions.
California buckeye	No	Not listed by TNC; not on wetland indicator list; anecdotal evidence that they tap into groundwater when available.
Agriculture/Farmland	No	
White alder	Yes	Uses surface water and shallow groundwater.
Bigberry manzanita	No	
Bare/Barren	No	
Freshwater wetland	Yes	Uses surface water and shallow groundwater.
Giant reed	Yes	
Coyote brush	No	Listed by TNC; not on wetland indicator list for CA; While Kidder PhD says "Dry season xylem waters for adult B. pilularis plotted near groundwater, indicating these plants likely relied on deeper water sources" many of our regional occurrences of this species do not indicate shallow groundwater and would likely be tolerant of groundwater table declines.
Mule fat	Yes	Uses surface water and shallow groundwater.
Developed	No	
Native grassland	No	
Chaparral	No	
Cord grass	Yes	Uses surface water and shallow groundwater.
Bare/Barren	No	
Developed	No	
Poison hemlock-Fennel	Yes	Conium indicator status = FACW[1]
Earth Lined Channels	Depends on location	
Freshwater wetland	Yes	Uses surface water and shallow groundwater.
Eucalyptus	Yes	Listed by TNC; only E. camaldulensis listed as FAC; regional distribution suggests groundwater dependent.
Exotic Trees, Canopy Height <2 Meters	Depends on location	
Exotic Trees, Canopy Height >15 Meters	Depends on location	
Exotic Trees, Canopy Height 2-15 Meters	Depends on location	
Bulrush	Yes	Uses surface water and shallow groundwater.
Seasonal wetland	Yes	Uses surface water and shallow groundwater.
Northern Californian walnut	Yes	Not listed by TNC; wetland indicator status = FAC; typically associated with creeks
Perennial pepperweed	Yes	
Grassland	No	
Agriculture/Farmland	No	
Open water	Depends on location	
California sycamore	Yes	

Fremont cottonwood	Yes	
Coast live oak	Depends on location	Listed by TNC; not on wetland indicator list for CA; US Forest Service says "Several deep main roots may tap groundwater if present within approximately 36 feet (11 m) of the soil surface. Coast live oak develops extensive horizontal root branches and surface-feeding roots." This species often grows near creeks, where it is likely groundwater dependent, but farther away it is not. Stands of this species alone should not be used to define GDEs unless in known shallow aquifer, near a waterway, and/or growing with other phreatophytes.
Blue oak	No	Not listed by TNC; no wetland indicator status; CNPS says *"Quercus douglasii* is a deciduous, drought and flood-tolerant tree that grows to 20 m in height. Its extensive roots can grow to 25 m and tap groundwater reserves." Regionally, however, this species is indicative of very dry, well drained, upland areas.
Valley oak	Yes	Listed by TNC; wetland indicator status = FACU[1]; uses deep groundwater.
Open water	No	
Developed	No	
Agriculture/Farmland	No	
Himalayan blackberry	Yes	Not listed by TNC; wetland indicator status = FAC; typically associated with wet areas.
Salt marsh	Yes	Uses surface water and shallow groundwater.
Salt marsh	Yes	Uses surface water and shallow groundwater.
Narrowleaf willow	Yes	Uses surface water and shallow groundwater.
Red willow	Yes	
Blue elderberry	Yes	Listed by TNC; wetland indicator status = FACU
Bulrush	Yes	Uses surface water and shallow groundwater.
Serpentine Component Mapping Unit	Depends on location	
Small Earthen Dam Ponds and Natural Lakes	Depends on location	
Mixed riparian forest	Yes	
Poison oak	No	Not listed by TNC; wetland indicator status = FACU; this species is found in many vegetation communities; position rather than presence may be more important for status
Cattail	Yes	Uses surface water and shallow groundwater.
California bay	Depends on location	Not listed by TNC; wetland indicator status = FAC; often associated with creeks/creek canyons, but often on extremely steep, well-drained slopes.
Water Group	No	
Freshwater wetland	Yes	Uses surface water and shallow groundwater.

Notes:

1) United States Army Corps of Engineers (USACE) wetland plant indicator status categories used in some descriptions are as follows:

OBL = Obligate Wetland Plants: Plants that occur almost always (estimated probability >99%) in wetlands in natural conditions but may also occur rarely in (estimated probability <1%) in non-wetlands.
FACW = Facultative Wetlands Plants: Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands
FAC = Facultative Plants: Plants with similar likelihood (estimated probability of 33% to 67%) of occurring in wetlands and non-wetlands
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UPL = Obligate Upland Plants: Plants that occur rarely in wetlands (estimated probability <1%), but occur almost always (estimated probability >99) in non-wetlands under natural conditions

2) TNC = The Nature Conservancy

2.2. Depth to Water (DTW) Map

A map of DTW was created to better understand surface water and groundwater interactions and to help identify and map the location of GDEs in the Santa Clara and Llagas subbasins. The DTW map was created using groundwater elevation and land surface elevation data. The shallow groundwater table elevation from wells within the confined portions of the Santa Clara Subbasin was obtained from GeoTracker (https://geotracker.waterboards.ca.gov/), which is the State Water Resource Control Board's statewide and online database of environmental sites that either impact or have the potential to impact water quality, with an emphasis on groundwater. GeoTracker has regulatory data about Leaking Underground Fuel Tank (LUFT) cleanup sites and solvent related releases formerly known as Spills-Leaks-Investigations-Cleanups (SLIC) sites, including time-series data of depth to the shallow groundwater table of various duration. Because these site investigations generally target the first encountered shallow groundwater table, the data is particularly relevant for mapping groundwater conditions that may support GDEs.

In addition to GeoTracker data, Valley Water's groundwater level monitoring data in the Santa Clara Subbasin recharge areas and some data obtained from well permit records at the time of drilling were used to better constrain and define the groundwater table. For the Llagas Subbasin, most of the water level data were from Valley Water's monitoring programs and very little data was from GeoTracker due to fewer contaminant release sites in that subbasin. Based on GeoTracker and Valley Water's monitoring programs, a total of 571 wells (454 wells in the Santa Clara Subbasin and 117 wells in the Llagas Subbasin) with water level data were used to create the DTW map. At each well location, the median of the time-series water-level elevation data between 2010 and 2019 was selected as a representative groundwater elevation. The period 2010–2019 was selected because it aligns with the groundwater budget and other components of the 2021 GWMP update.

2.2.1. Digital Elevation Model and Groundwater Level Contours

As described above, the median groundwater elevation from the 571 wells was used to create a digital surface model of the shallow groundwater table using GIS software (Figures 8 and 9). A digital elevation model of the groundwater surface was created in ArcMap using the inverse distance weighted interpolation method that estimates cell values by averaging sample points in the neighborhood of each processing unit. The weight of each sample point is inversely proportional to its distance from the cell being processed. Valley Water used the nearest 12 neighboring sample points and set the output cell size to 30 feet. The resulting digital surface is contoured to visualize groundwater elevations in the Santa Clara (Figure 8) and Llagas (Figure 9) subbasins.

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Figure 8. Median 2010–2019 Groundwater Elevation Contours for the Santa Clara Subbasin, 10 feet interval.

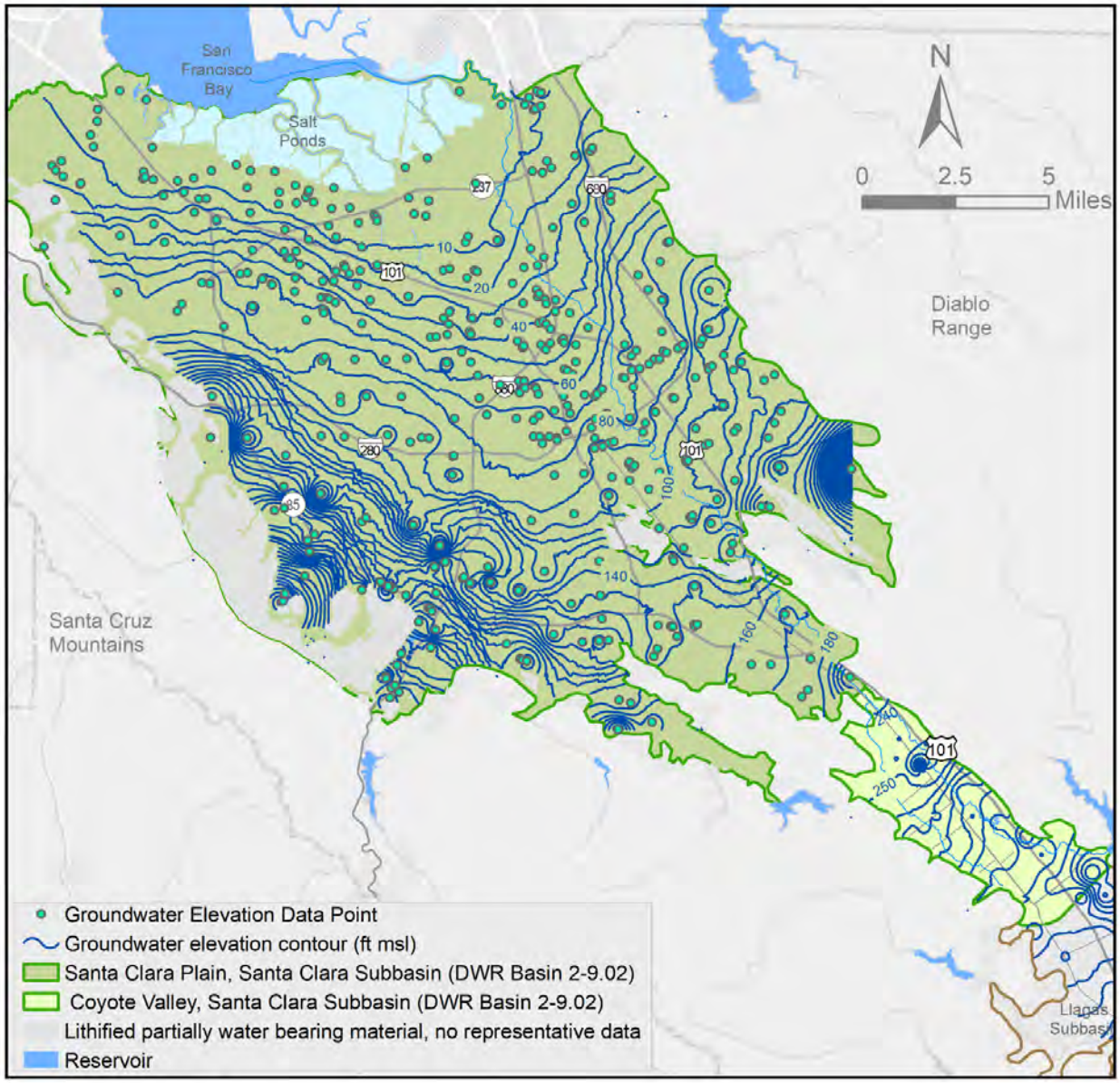

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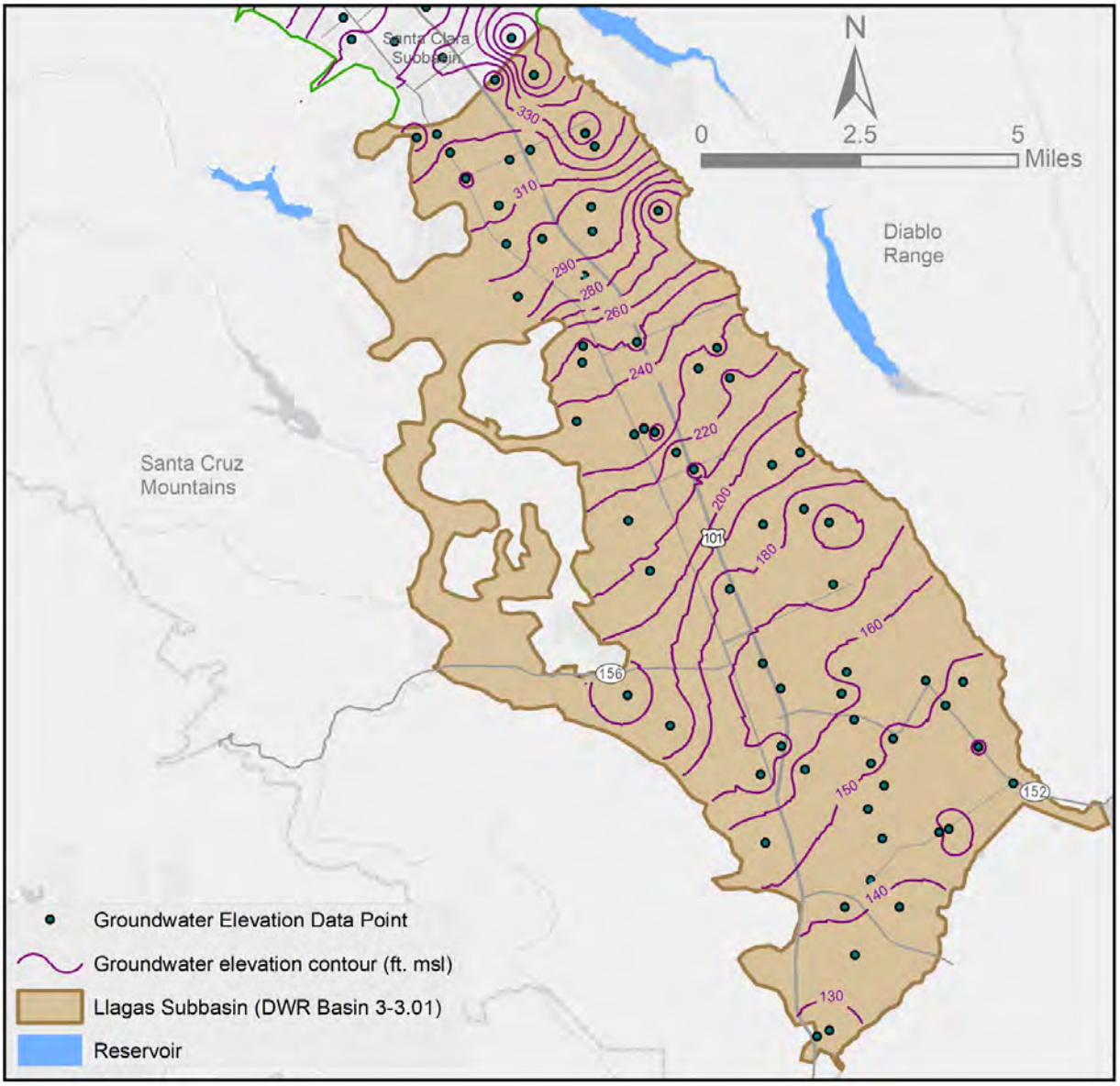
Figure 9. Median 2010–2019 Groundwater Elevation Contours for the Llagas Subbasin, 10 feet interval.



2.2.2. Land Surface Elevation (LIDAR) and DTW Map

An accurate digital land surface model created with specialized pulsed laser technology known as LIDAR is available as part of Valley Water's GIS resources. The countywide LIDAR dataset currently available provides a very accurate elevation model of the earth's surface at high resolution (30 ft). To create the DTW map Valley Water used the ArcMap raster calculator function to subtract the groundwater surface (raster) from the LIDAR land elevation surface (raster). Each raster was created with the same cell size, which enables the highest possible resolution and detail in the resulting DTW map. The DTW maps are presented in Figures 10 and 11 for the Santa Clara and Llagas subbasins, respectively.

Figure 10 Median 2010–2019 Depth to Groundwater for the Santa Clara Subbasin.

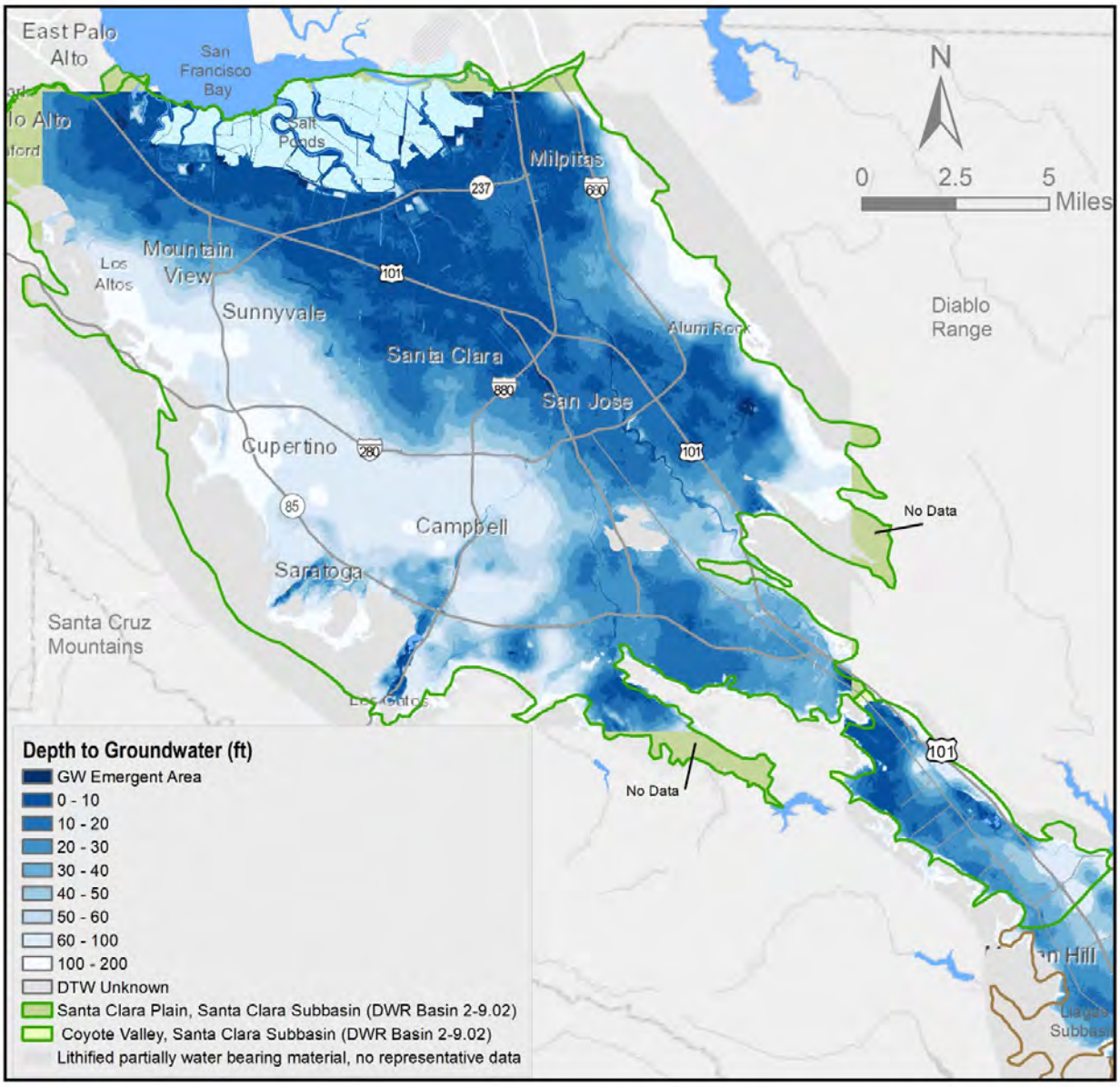


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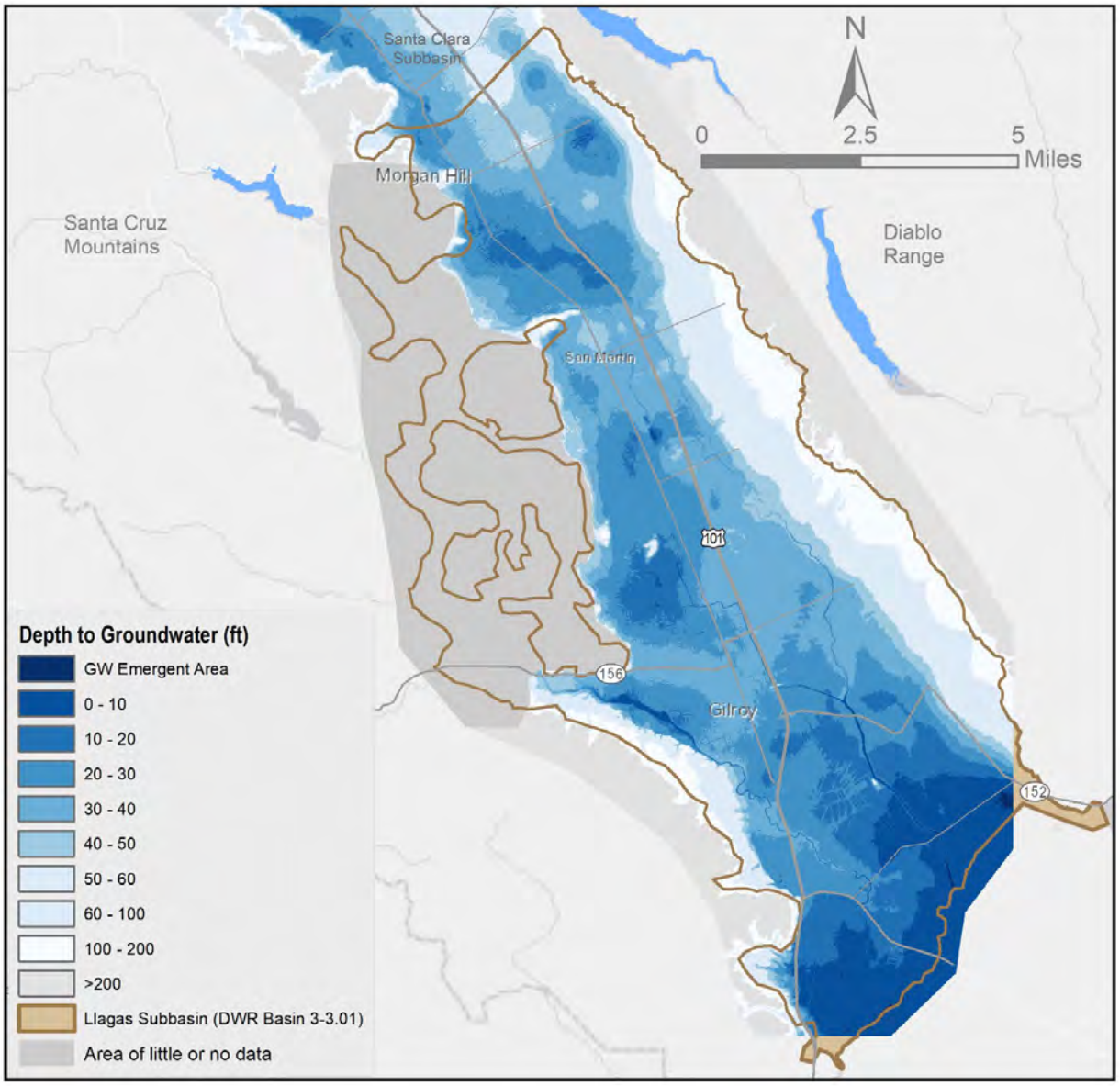
Figure 11. Median 2010–2019 Depth to Groundwater for the Llagas Subbasin.



2.3. Preliminary Identification of GDEs

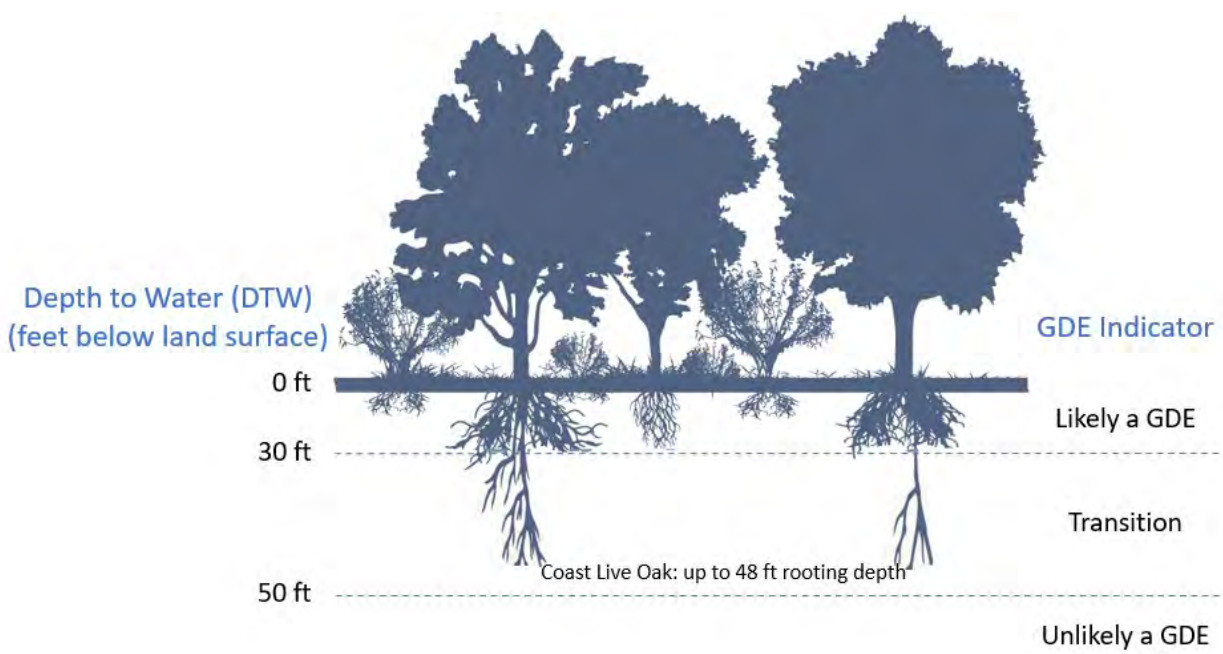
The maps of vegetation and land cover (Figure 7) and DTW (Figures 10 and 11) were used to create a preliminary GDE map. To create the preliminary GDE map, Valley Water first removed all vegetation types not identified as California phreatophytes by Valley Water biologists, then removed any phreatophytes outside of the subbasin boundaries. Then a geographic overlay analysis was performed using the retained phreatophyte polygons and the DTW map. Based on the TNC GDE guidance, Valley Water used three DTW ranges as a preliminary indicator of GDEs (Table 3).

Table 3. Preliminary Indicators of Groundwater Dependent Ecosystems (GDEs) Based on Depth to Water (DTW). (Modified from Rohde et al., 2018).

Depth to water range	GDE Indicator
Less than 30 feet	*Likely a GDE*
30 – 50 feet	*Transition*
Greater than 50 feet	*Unlikely a GDE*
Unknown	*Possible GDE*

The TNC GDE indicators (likely, transition, and unlikely) (Table 3) are largely based on the rooting depths of California phreatophyte species (Rohde et al, 2018) (Figure 12). The TNC guidance states that less than 30 feet DTW is likely indicative of groundwater dependance. Consequently, any vegetation polygon overlying DTW of 30 feet or less is identified as a likely GDE on the preliminary map. Although the DTW range of 0 to 30 feet encompasses many different types of groundwater dependent species, the goal is to broadly classify all communities that are likely dependent on groundwater. In addition, the TNC approach defines a 'transition' zone as between 30- and 50-feet DTW. This is a conservative approach to identify GDEs because some California phreatophytes have rooting depths greater than 30 feet but less than 50 feet, such as the California Live Oak that has a reported rooting depth of up to 48 feet below land surface (Figure 12). The rooting depth of most California phreatophytes is less than 50 feet. Therefore, vegetation is unlikely a GDE in areas with DTW greater than 50 feet (Figure 12). While DTW is mapped across most areas of the subbasins, there are some small areas where DTW data is unavailable, including the western area of the Llagas Subbasin (Figure 11). To be consistent with the TNC GDE guidance, in areas where DTW is unknown, Valley Water used a fourth GDE indicator called 'possible GDE' to reflect phreatophytes located in areas of unknown DTW.

Figure 12. Indicator of Groundwater Dependent Ecosystems Based on Depth to Water and Rooting Depth of California Phreatophytes. (Modified from Rohde et al., 2018).



Many upland areas in the Santa Clara and Llagas subbasins have DTW greater than 50 feet (Figure 10 and 11). Phreatophyte polygons overlying the greater than 50 feet DTW are not shown on the final GDE maps. Some of these upland areas have known or suspected discharge via storm drains that supports small, localized patches of vegetation that otherwise would be indicative of groundwater dependence. In the highly urbanized Santa Clara Subbasin, storm drains can flow throughout the dry season because of dewatering projects, runoff of excess irrigation water, broken or leaky pipes, draining of swimming pools, etc. Two such cases are described in detail below.

To facilitate identifying preliminary GDE polygons in ArcMap, Valley Water first contoured the DTW map and retained only the contour lines that define the three DTW range categories (less than 30 feet, 30 to 50 feet, and greater than 50 feet), as discussed above. The contour lines were converted into polygon format coverages that define the three DTW categories (Figures 13 and 14). The vegetation and land cover map (Figure 7) was overlain on Figures 13 and 14 to categorize the preliminary GDEs as likely, transition, or unlikely based on the three DTW ranges. The possible GDE category was applied to areas of the Llagas Subbasin where DTW is unknown (Figure 14).

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Figure 13. Simplified Depth to Water Contour Ranges for the Santa Clara Subbasin; Less than 30 feet, 30 – 50 feet, and Greater than 50 feet.

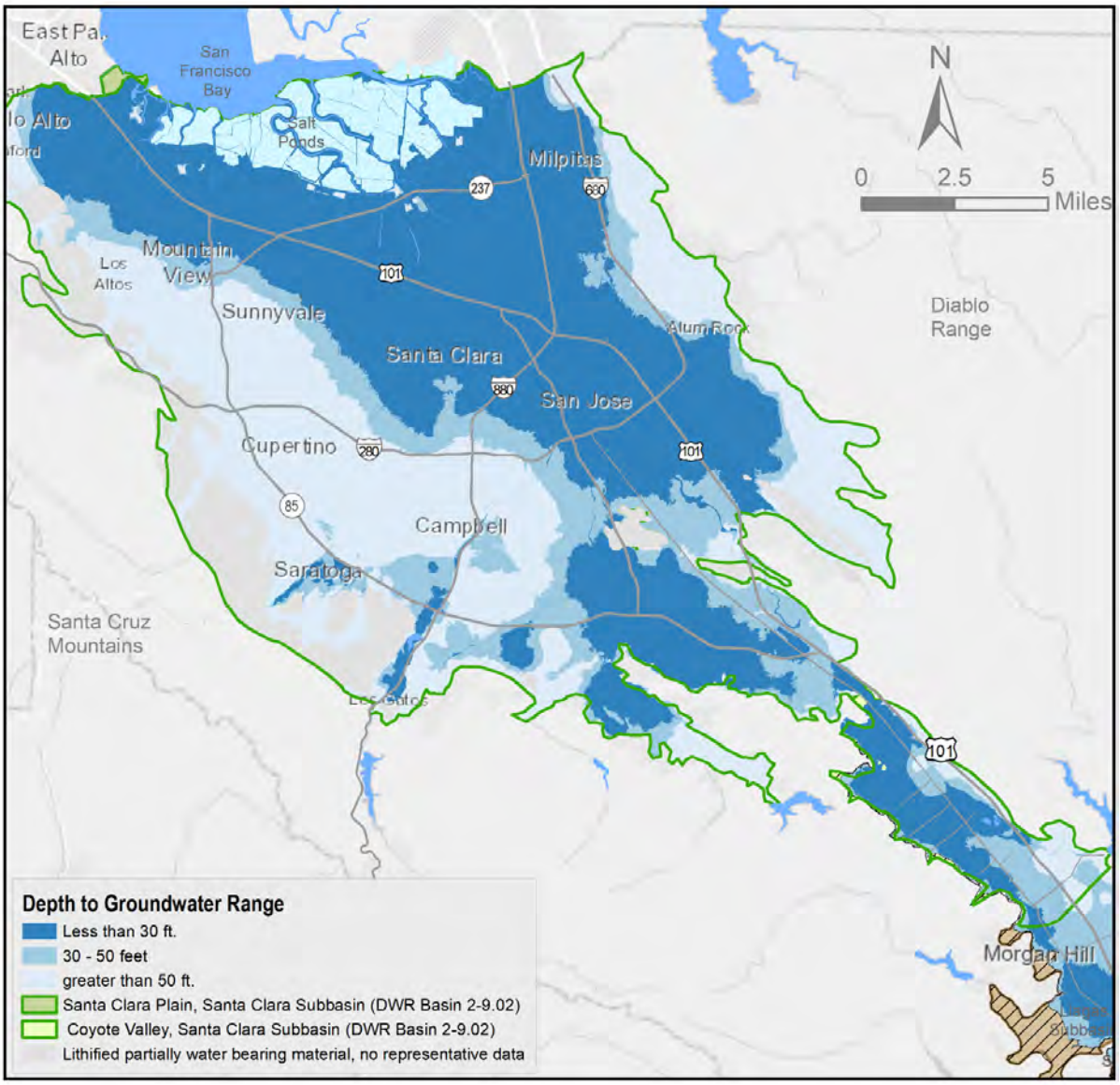

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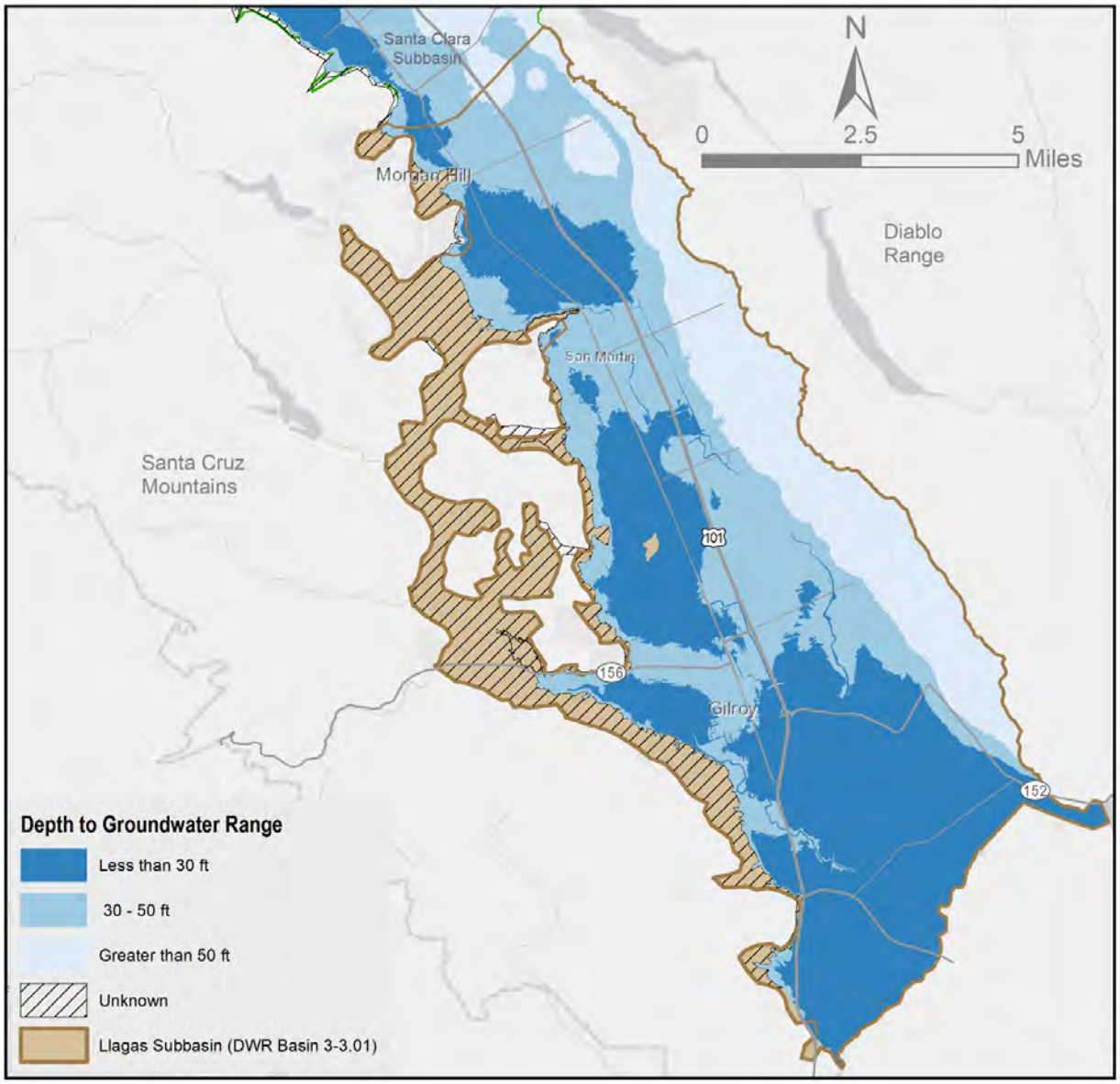
Figure 14. Simplified Depth to Water Contour Ranges in the Llagas Subbasin; Less than 30 feet, 30 – 50 feet, and Greater than 50 feet.



2.4. Map of GDEs

The following maps (Figure 15–17) illustrate how the previously described GIS datasets and preliminary GDE map (Figure 16) were used to create the final GDE map (Figure 17) for Santa Clara and Llagas subbasins. All California phreatophytes from the merged vegetation and land cover map (Figure 7) that are within the Santa Clara and Llagas subbasin boundaries are shown in Figure 15. All California phreatophytes are categorized in Figure 16 as likely GDEs (DTW less than 30 feet), transition (DTW 30 to 50 feet), unlikely GDEs (DTW greater than 50 feet), or possible GDEs (DTW unknown in the Llagas Subbasin). The final GDE map shows all California phreatophytes that are either in the likely GDE,

transition, or possible GDE category (Figure 17). It should be noted that this *"final"* GDE map (Figure 17) will be revised and updated as new data and understanding of the groundwater conditions becomes available during each five-year GWMP update cycle. Since many of the GDE polygons are very small and narrow, Valley Water plans to make the GDE map available for viewing on Valley Water's Open Data pages (https://data-valleywater.opendata.arcgis.com/).

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Figure 15. All California Phreatophytes from the Merged Vegetation and Land Cover Map that are within the Santa Clara and Llagas Subbasins.

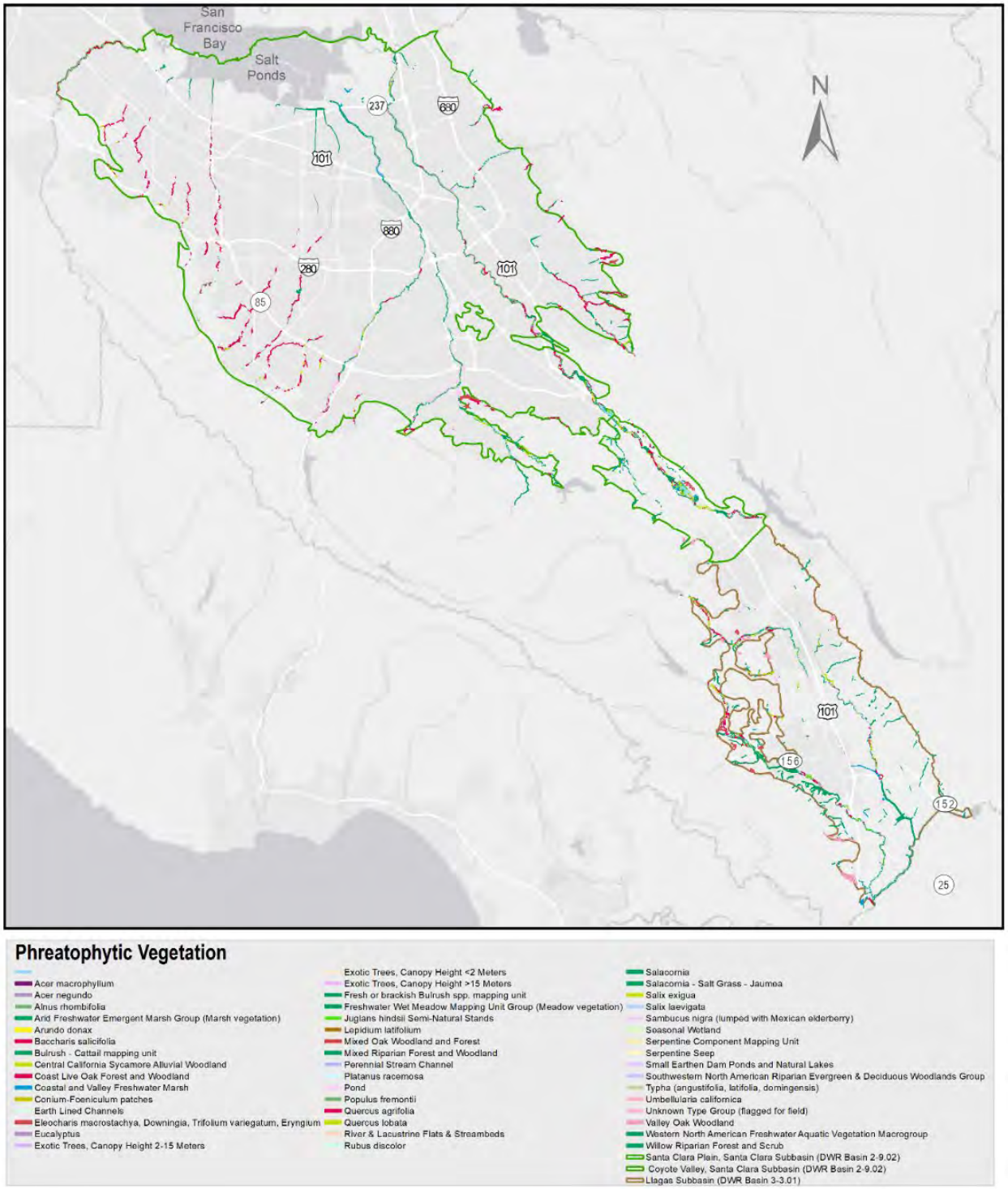

Figure 16. All California Phreatophytes Categorized as Likely GDEs (DTW less than 30 feet), Transition (DTW 30 to 50 feet), Unlikely GDEs (DTW greater than 50 feet), or Possible GDEs (DTW unknown).

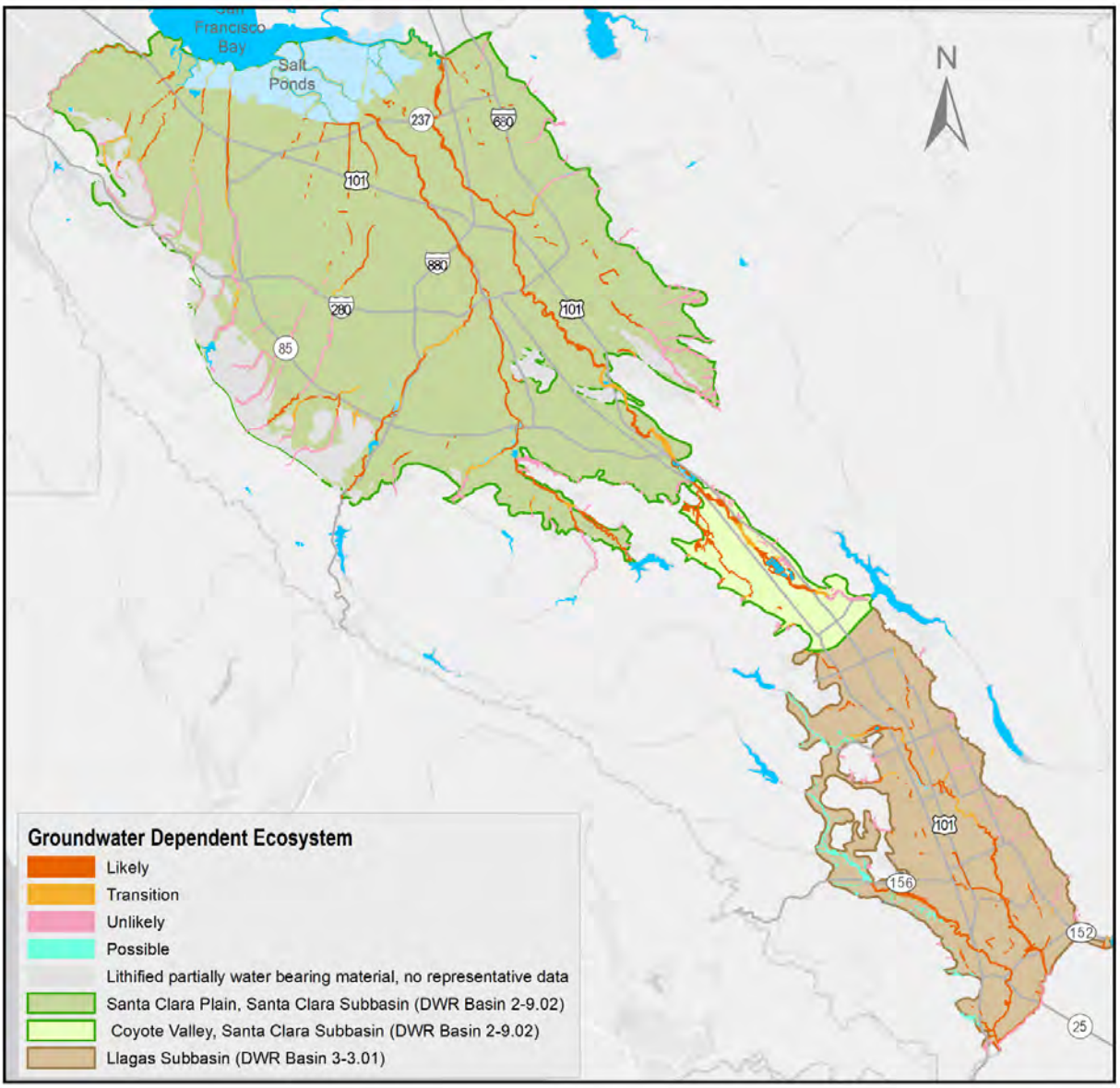

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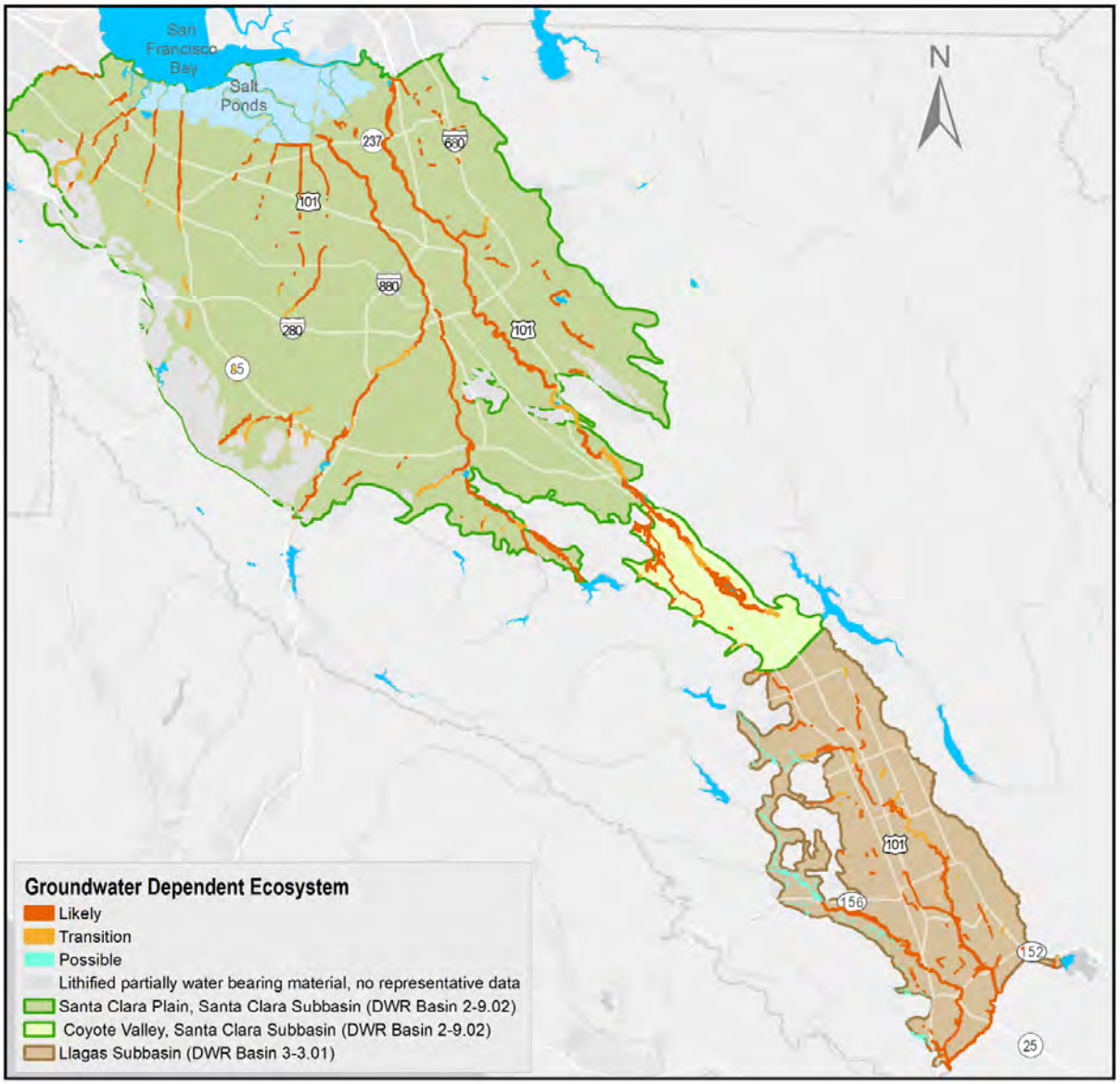
Figure 17. Final GDE Map Includes All California Phreatophytes in the Likely GDE, Transition, or Possible GDE Categories.



Note: Phreatophytes not retained on this final map are likely supported by surface-water augmented flows from reservoir releases, local urban stormwater discharge, dewatering projects, or shallow perched groundwater that is not connected to the regional aquifers. Some phreatophytes retained on the map may also benefit from these sources of water in addition to groundwater access.

3. Results and Discussion

The final GDE map shown in Figure 17 is based on all California phreatophytes in the likely (DTW less than 30 feet), transition (DTW 30 to 50 feet), and possible GDE (DTW unknown) categories. The majority of the GDEs are located along stream reaches and in known wetlands, such as the Laguna Seca area of northern Coyote Valley. Most of these stream reaches are losing reaches (Figure 1) and are actively used in Valley Water's managed in-stream recharge operations.

3.1. Influence from Reservoir Releases

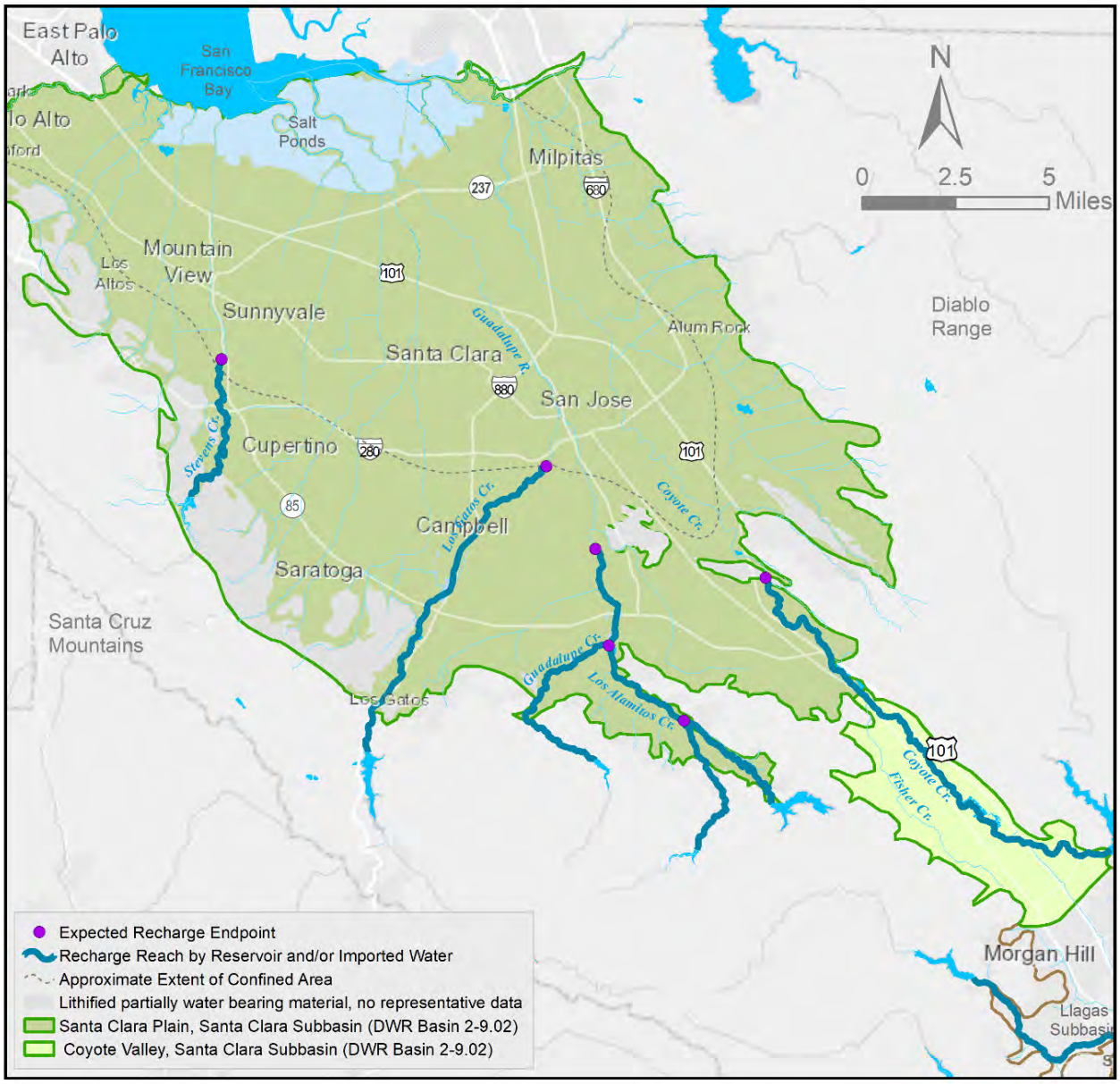
Natural streamflow and operational releases from Valley Water's 10 local reservoirs provide nearly perennial flows during most years in many of the losing stream reaches that were historically ephemeral streams prior to Valley Water's operations. Typically, under natural conditions, perennial streams are gaining streams (Figure 1) that are supported by baseflow from groundwater discharge, and thus are usually indicative of interconnected surface water and GDEs. However, Valley Water's reservoir releases have created nearly perennial streams in losing stream reaches that are disconnected from the regional water table (Figure 1), and thus are not interconnected surface water or GDEs under SGMA definitions. Therefore, the unlikely GDE category (DTW greater than 50 feet) was not included in the final GDE map (Figure 17).

Reservoir releases have resulted in nearly perennial flows downstream for several miles (Figure 18 and 19) along these losing stream reaches and support associated riparian corridors with many vegetations types normally indicative of wetland ecology and groundwater dependance. As previously explained, much of the riparian communities depend solely on surface water releases from reservoir operations, rather than depend on groundwater discharge. These reaches augmented by reservoir releases are largely losing reaches that recharge the subbasins (Figures 18 and 19). Some of the upstream reaches that overlie DTW greater than 50 feet were categorized as unlikely GDEs and not retained on the final GDE map (Figure 17). However, many of the downstream reaches overlie transition and likely GDE DTW categories and contain GDEs that are supported by both surface water augmented flows and groundwater. Thus, some GDEs represented in Figure 17 are supported solely by groundwater and others are supported by a combination of surface water and groundwater. Along these reaches, it is very difficult to distinguish between the GDEs that are support by groundwater only and those supported by a combination of surface water and groundwater since the resultant phreatophytic vegetation suite is essentially identical. Phreatophytes were categorized as possible GDEs in the valleys downstream of Uvas and Chesbro reservoirs on the western side of the Llagas Subbasin because there is no groundwater level to further categorize the areas as likely, transition, or unlikely GDEs. As discussed below, additional groundwater monitoring may be needed in these areas downstream of Uvas and Chesbro reservoirs to better characterize the possible GDEs.

Because local reservoirs were constructed for groundwater recharge purposes, Valley Water manages reservoir releases to minimize excess flows past the expected recharge end points (Figures 18 and 19) and into the interior confined portions of the subbasin because this water would likely discharge to the Bay rather than recharge the underlying principal aquifer zone.[3] These riparian corridors highlighted in Figures 18 and 19 offer many ecological services in addition to groundwater recharge including fish passage, fish spawning, bird refuge and feeding areas, and local wildlife corridors, to name a few. The downstream reaches of these streams over the confined, interior portions of the subbasin are not directly supported by reservoir and recharge operations.

[3] Reservoir releases are made in accordance with environmental regulations, which may require specific flows in some areas.

Figure 18. Stream Reaches Augmented from Local Reservoirs and Imported Water Pipelines for Groundwater Recharge Operations in the Santa Clara Subbasin.



Note: the stream reaches highlighted in this map are augmented from releases from local reservoirs and imported water, depending on the availability of local versus imported supplies.

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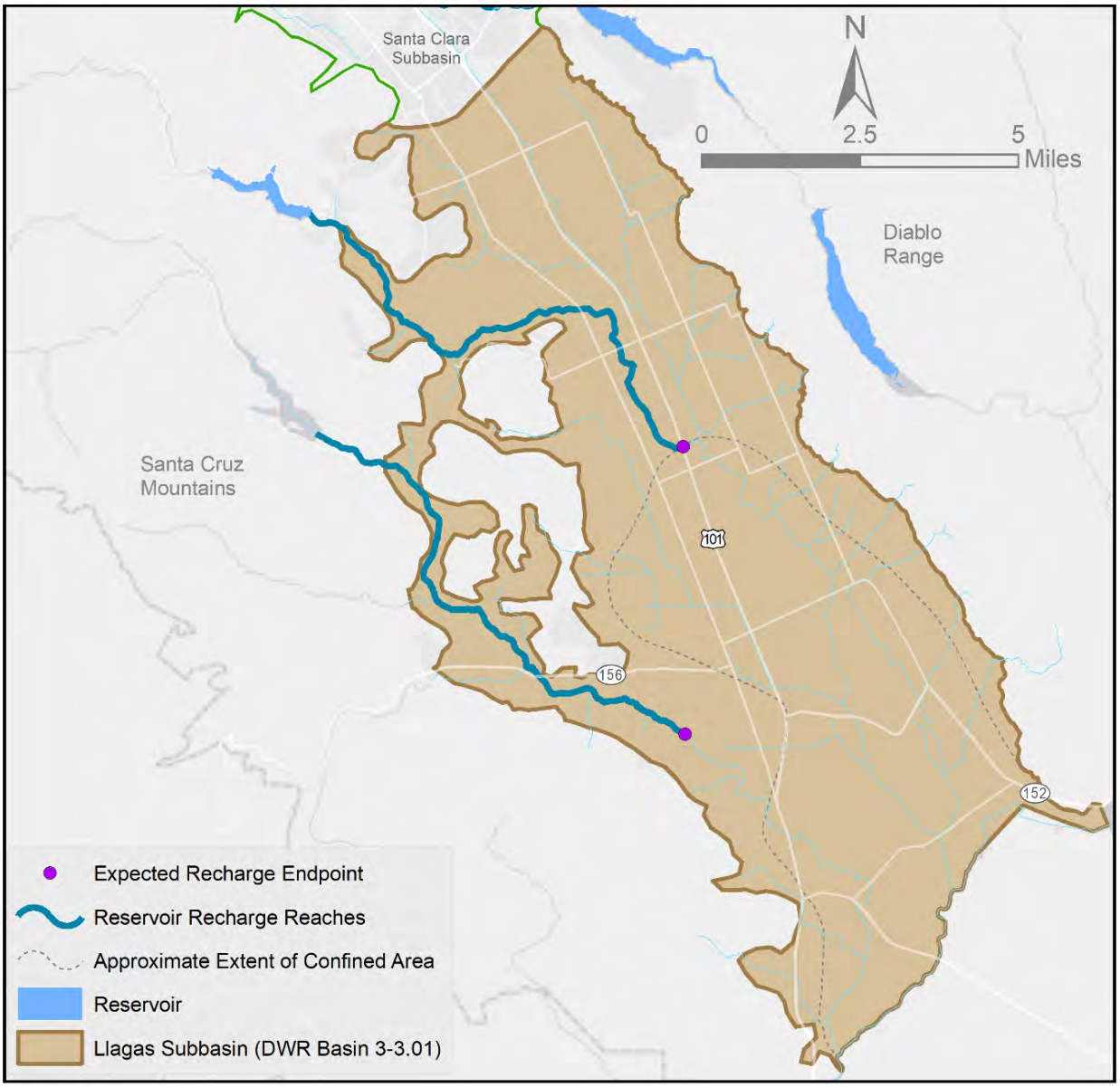
Figure 19. Stream Reaches Augmented by Reservoir Releases for Groundwater Recharge Operations in the Llagas Subbasin.

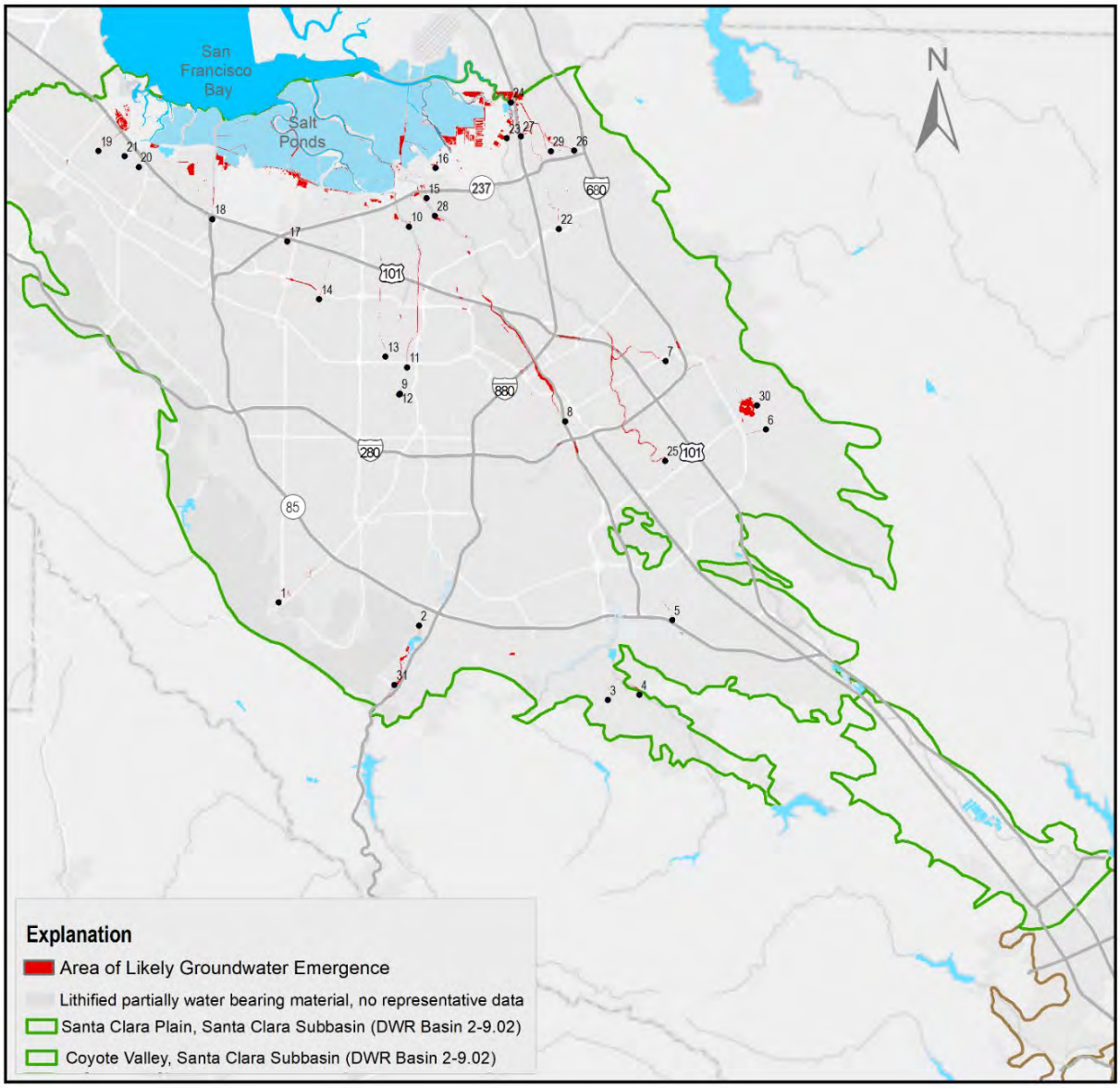


Note: the stream reaches highlighted in this map are augmented from releases from local reservoirs only.

3.2. Gaining Reaches and Groundwater Emergent Zones

Analysis of groundwater elevation data and topography indicates that flows in certain stream reaches are areas of groundwater discharge and emergence. Groundwater emergence areas are shown in Figures 10 and 11 and refer to locations where the water table intersects the incised creek channel and other low-lying areas not in creek channels. Groundwater emergence areas support GDEs where wetland vegetation and associated communities thrive. These areas are characterized by slow moving water present throughout the summer dry season, aquatic vegetation, waterfowl, and dense stands of riparian vegetation. For example, the likely groundwater emergent areas in the Santa Clara Plain from Figure 10 are highlighted in Figure 20. The numbered locations in Figure 20 correspond to the 'Map Identification Number' in Table 4. The location, extent, and general characteristics of groundwater emergent areas are described in Table 4.

Figure 20. Likely Groundwater Emergent Areas in the Santa Clara Plain.



Note: Numbered locations are described in Table 4.

Interestingly, some groundwater emergent areas (Figure 20) are not located where one might expect, such as near the southern shore of the San Francisco Bay – the lowest topographic point in the subbasin. Rather, there are some groundwater emergent areas further upstream near the center of the subbasin on major drainages such as Coyote Creek and Guadalupe River (Figure 20). These groundwater emergent areas near the center of the subbasin (ex. location numbers 7–9, 11–13, and 25 in Figure 20), tend to align with the areas of historic subsidence. Valley Water hypothesizes the historic land subsidence of almost 14 feet near downtown San Jose created a subsidence bowl that now enhances groundwater emergence. Near the bay shore there are some groundwater emergent areas but these are generally less pronounced and not within the creek channels, but rather located outboard of the creek channel coinciding with the lowest topographic elevation. For example, along Guadalupe River, downstream of Tasman Avenue between Highway 237 there are several groundwater emergent areas outboard of the channel but none within the channel (ex. location numbers 15 and 28 in Figure 20).

Table 4 describes each significant groundwater emergence area associated with stream reaches numbered in Figure 20. Numerous other surface expressions of groundwater in the form of ponds and estuaries are noted around the southern portions of the Bay but not described here individually. Some of the groundwater emergent areas near the bay shore are likely tidally influenced. No data was available outboard of the levee system into the former salt evaporators though the interpolated DTW surface (Figure 13) stretches into that area, which should be interpreted with caution due to the lack of control points.

Table 4. Description of Groundwater Emergent Areas.

Map Identification Number in Figure 20	Creek Name	Emergent Area Description
1	Saratoga Creek	Saratoga Cr. at Saratoga-Sunnyvale Rd about 2,400 linear feet of channel (upstream and downstream of street overcrossing)
2	Los Gatos Creek	Los Gatos Creek upstream of Lark Ave crossing approx. 500 linear feet of stream channel
3	Golf Creek	Between Camden Ave & and Redmond Ave, approx. 2,500 ft. of stream channel exhibits some evidence of groundwater emergence
4	Alamitos Creek	Beginning approx. 2,400 ft downstream of Graystone Lane, then continuing downstream approx. 3,000 ft to near terminus of Fleetwood Dr.
5	Canoas Creek	Beginning near CA 85 overcrossing approx. 3,600 ft. downstream to near Hyde Park Dr.
6	Norwood Creek	From S. White Rd. downstream to confluence with Lower Silver Creek. Approx. 3,000 ft.
7	Lower Silver Creek	From Sunset Ave. downstream nearly 5,000 ft. to confluence with Coyote Creek
8	Guadalupe River	From CA 87 downstream through Guadalupe River Park and San Jose International Airport to Trimble Rd. Approximately 22,400 ft.
9	San Tomas Aquino Creek	From near confluence with Saratoga Cr. Approx. 13,000 ft downstream to near Great America
10	San Tomas Aquino Creek	Intermittent emergent areas from near Tasman to downstream of State Route 237 (approx. 5,200 ft.)

Map Identification Number in Figure 20	Creek Name	Emergent Area Description
11	Saratoga Creek	From near El Camino Real to confluence with San Tomas Aquino Creek, approx. 5,000 ft.
12	Saratoga Creek	Small emergent zone, 1,700 ft in length within Santa Clara's Central Park, wholly bounded by Bowers and Benton Ave.
13	Calabazas Creek	From Warburton Ave downstream 14,000 ft. beyond Highway 101 to near Mission College Baseball field. Note, much of this channel section is concrete lined.
14	Sunnyvale East Channel	Intermittent emergent areas from Kifer Rd. downstream approx. 15,000 ft to Caribbean Dr.
15	N/A	Open water area east of Guadalupe R. and south of SR237, located in mobile home park (Shorewood Lane) approx. area 125,000 ft^2
16	N/A	Possible tidal influenced channel near Alviso (Los Esteros Road & Grand Blvd intersection) about 1,500 ft in length
17	Sunnyvale West Channel	Intermittent emergent zone 2,700 ft in length from about US 101 to downstream of SR 237
18	Stevens Creek	From near US 101 downstream to Google Bay View Campus (Charleston Rd.), about 4,700 ft.
19	Matadero Creek	From Middlefield Road downstream to US 101 4,000 ft (and beyond into Baylands). Note, much of this channel is concrete lined.
20	Adobe Creek	About 600 ft. apparent emergent zone upstream of the US 101 overcrossing. Note, this portion of channel is concrete lined.
21	Barron Creek	Intermittent emergent zone from Louis Dr. downstream about 2,000 ft to near US 101. Note, portions of this channel segment are concrete lined.
22	Lower Penitencia Creek	From Montague Exp. to terminus at confluence with Coyote Cr. approx. 20,000 ft. Upstream of SR 237, some portions are intermittently emergent.
23	Coyote Creek	Emergent zone from confluence with Lower Penitencia Cr. Upstream approx. 5,500 ft.
24	Coyote Creek	Downstream from confluence of Lower Penitencia Cr. for at least 4,500 ft (to edge of mapped data)
25	Coyote Creek	Nearly continuous emergent zone from Tully Rd. to about 800 feet downstream of Mabury Rd. Spans approximately 26,000 ft (5 miles) of stream channel
26	Berryessa Creek	From N. Hillview Dr. downstream about 8,000 ft. to confluence with Lower Penitencia Cr.
27	Un-named drainage	About 4,500 ft emergent zone adjacent to Hwy 880 northbound lanes from Dixon landing exit (east) southward. May be concrete lined in portions
28	Un-named drainage	Adjacent to Guadalupe R. between Tasman Blvd. and SR 237. Approx. 4,000 ft. in length. Outboard side of levee, west side of river.
29	Wrigley Ford Creek	From confluence with Berryessa Cr. upstream about 3,000 ft.

Map Identification Number in Figure 20	Creek Name	Emergent Area Description
30	Ruby and Flint Creeks	Emergent zones surrounding portions of Lake Cunningham Regional Park. About 3,500 linear feet in total
31	Los Gatos Creek	From Los Gatos-Saratoga Rd. downstream about 5,000 ft into Lake Vasona County Park

3.3. Field Verification of GDEs

To verify the accuracy of the final GDE map (Figure 17), biological inspections and assessment of GDEs were conducted at 34 targeted sites in the Santa Clara and Llagas subbasin. Most sites targeted phreatophytes within the transition (DTW 30–50 feet) and unlikely (DTW greater than 50 feet) areas (Figure 16). Except for Laguna Seca in northern Coyote Valley, very few sites targeted the likely GDE (DTW less than 30 feet) areas (Figure 16) because of the higher confidence in groundwater dependent conditions (Rhode et al., 2018). All field verification sites and outcomes are shown on Figures 21 –23 and listed in Table 5. At each site, Valley Water biologists conducted a Vegetation Rapid Assessment, which is a method supported by the California Department of Fish and Wildlife and the California Native Plant Society. Based on the results of the Vegetation Rapid Assessment, the biologists further categorized each site following the TNC recommendations of *likely* or *not likely* a GDE (Figure 21 and 22, and Table 5).

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Figure 21. Field Verification Sites and Outcomes in the Santa Clara Plain.

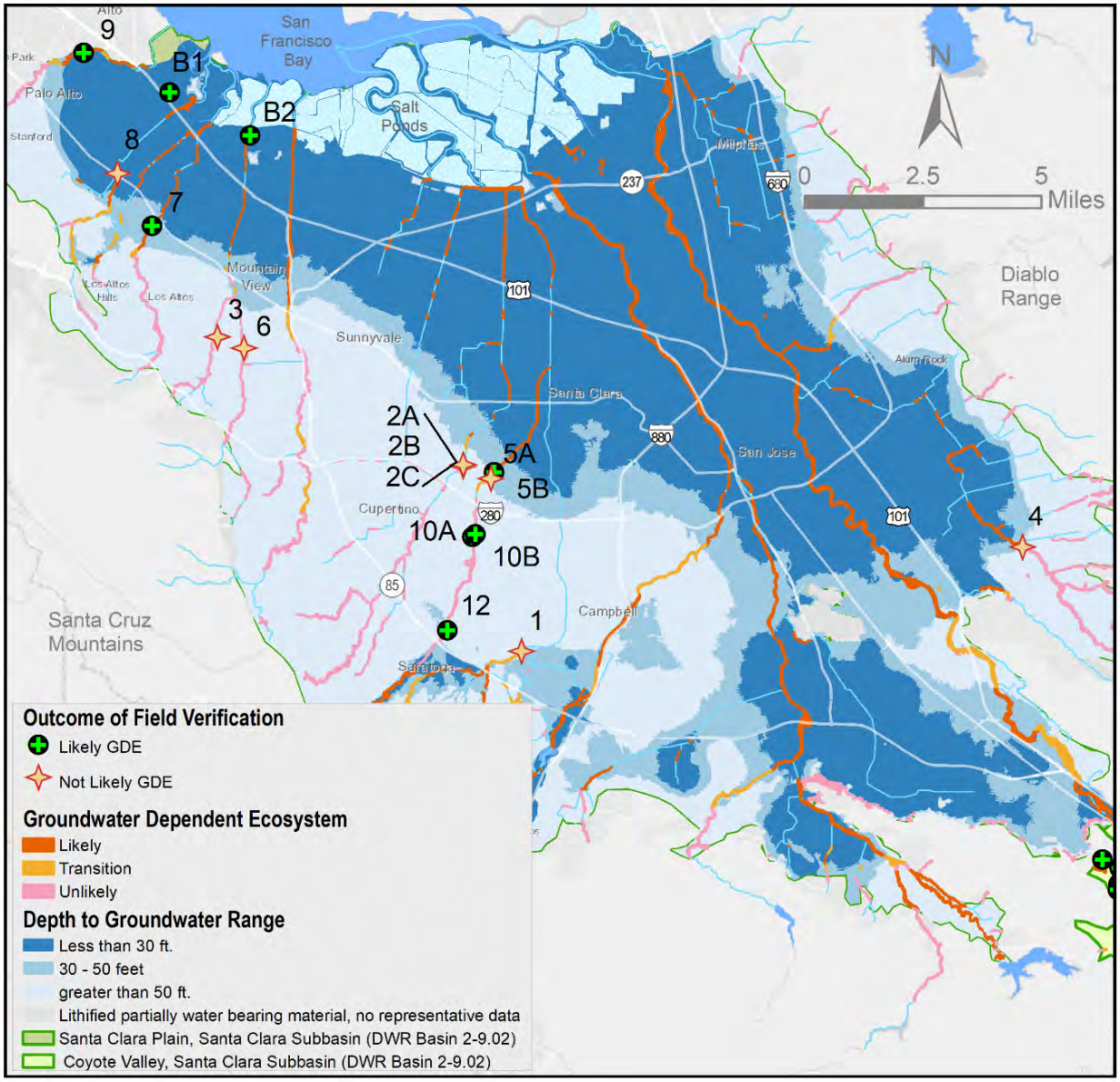

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Figure 22. Field Verification Sites and Outcomes in the Laguna Seca Area, Coyote Valley.

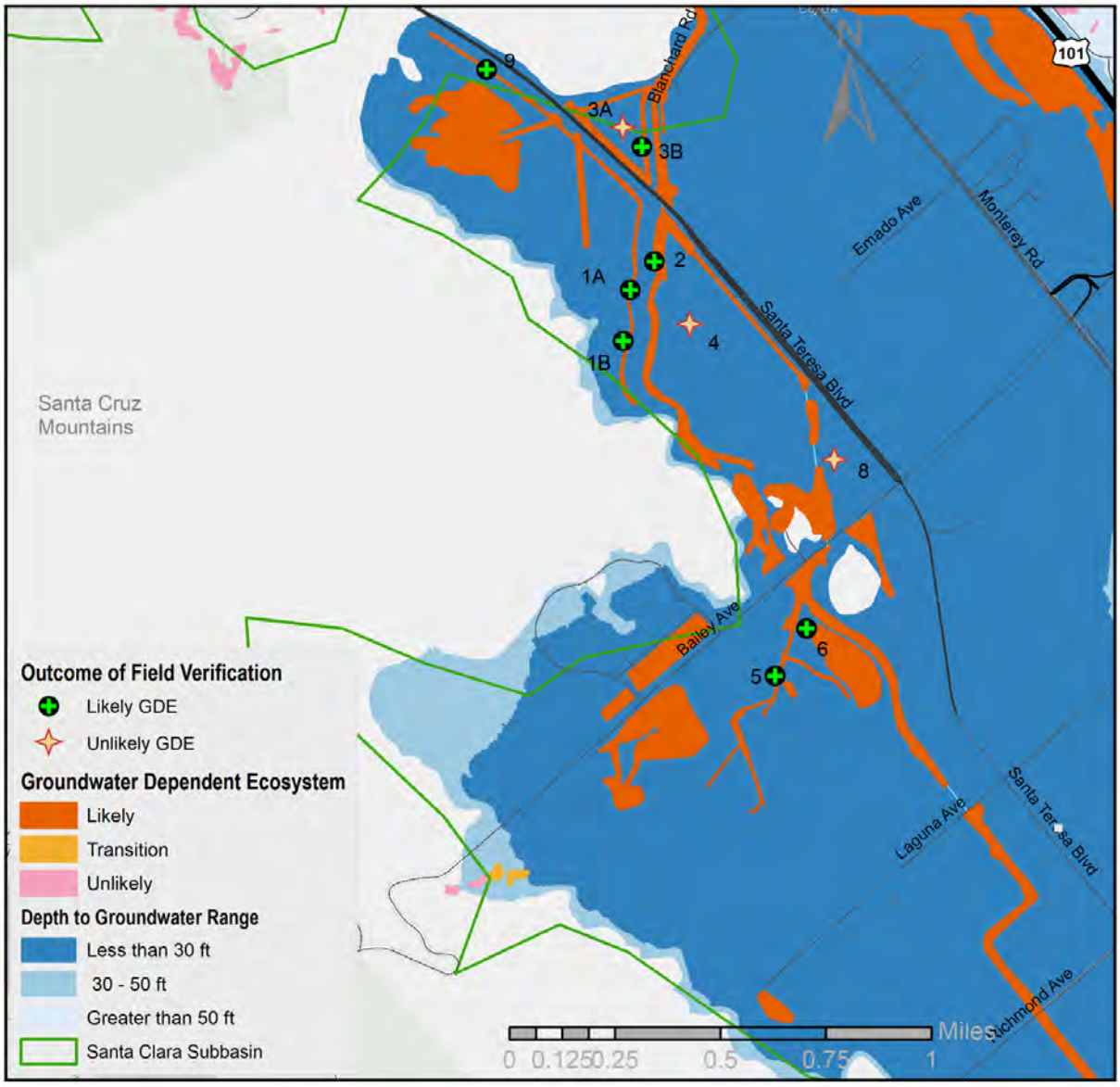

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Figure 23 Field Verification Sites and Outcomes in the Coyote Valley and Llagas Subbasin.

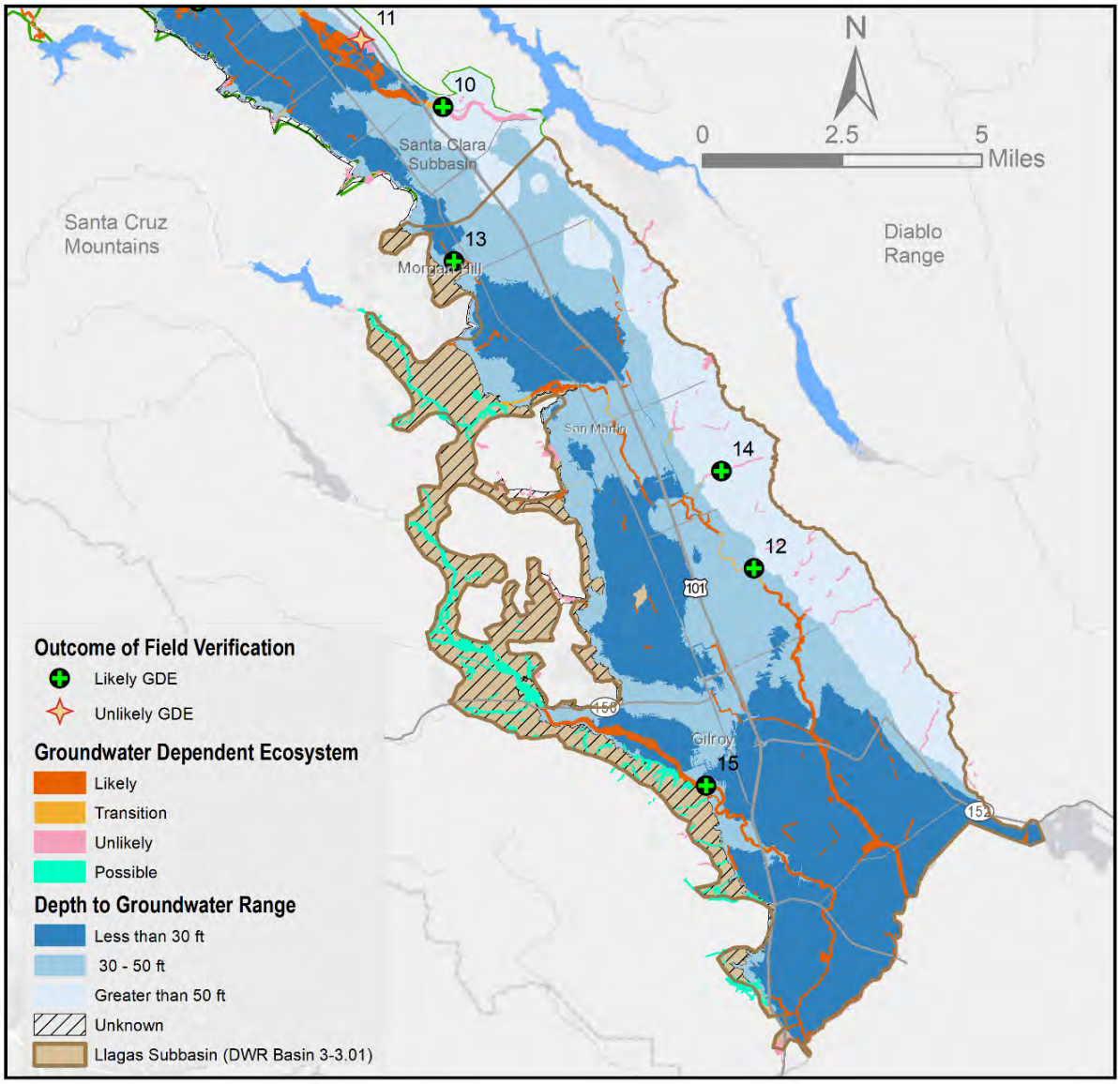

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Table 5. Field Verification Sites and Outcomes in the Santa Clara Subbasin (Note – Site numbers refer to Figure 21).

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
Site 1, San Thomas Aquino @ McCoy	10/14/2020	Oak Woodland	Coast Live Oak Woodland	Not Likely	Coast live oak is listed as a CA phreatophyte by TNC, and US Forest Service says "Several deep main roots may tap groundwater if present within approximately 36 feet (11 m) of the soil surface. Coast live oak develops extensive horizontal root branches and surface-feeding roots." This species often grows near creeks, where it is likely groundwater dependent, but farther away it is not. It is not listed as a wetland indicator species by U.S. Army Corps of Engineers (USACE). As such, stands of this species alone should not be used to define GDEs unless in known shallow aquifer, near a waterway, and/or growing with other phreatophytes. At this site, associated species (e.g., Valley oak, privet, poison oak) are not suggestive of groundwater dependence and vegetation did not pass the USACE dominance test for wetland vegetation.
Site 5A, Saratoga Creek @ Pruneridge 1	10/14/2020	Exotic Tree	Tree layer does not pass dominance test but valley oak listed by the TNC as using deep groundwater.	Likely	Sycamore is listed as a CA phreatophyte by TNC and the site passes the USACE dominance test for wetland vegetation.
Site 5B, Saratoga Creek @ Pruneridge 2	10/14/2020	Oak Woodland	Coast Live Oak Woodland	Not Likely	Same as above re: coast live oak. At this site, associated species are not suggestive of groundwater dependence and vegetation would not pass the USACE dominance test. (Dominant tree and shrub species at this site are Not Listed by USACE (coast live oak, holly oak, and french broom) but most oak species in the Arid West region are listed as FACU or UPL, and would not pass the dominance test.)

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
Site 2A, Calabazas @ Pruneridge1	10/14/2020	Oak Woodland	Coast Live Oak Woodland	Not Likely	Same as above re: coast live oak. At this site, associated species are not suggestive of groundwater dependence and vegetation would not pass the USACE dominance test. (Dominant tree and shrub species at this site are Not Listed by USACE (coast live oak, coyote brush) but most oak species in the Arid West region are listed as FACU or UPL and would not pass the dominance test.) This plot is on top of the bank slope, which is made up of gabion baskets, which may be altering hydrology, and was planted as a flood protection project.
Site 2B, Calabazas @ Pruneridge2	10/14/2020	None	Mediterranean Perennial Grassland	Not Likely	Perennial grassland is not a CA phreatophyte. At this site, the grass and herbaceous species are suggestive of seasonal surface water presence, not of shallow groundwater.
Site 2C, Calabazas @ Pruneridge3	10/14/2020	Coast Live Oak Woodland	Coast Live Oak Woodland	Not Likely	Same as above re: coast live oak. At this site, the dominant tree - coast live oak - is Not Listed and the dominant shrub - English ivy - is FACU so does not pass the USACE dominance test for wetland vegetation.
Site 6, Permanente @ St Francis	10/14/2020	Oak Woodland	Coast Live Oak Woodland	Not Likely	Same as above re: coast live oak. t this site, the dominant tree - coast live oak - is Not Listed and the dominant shrub - English ivy - is FACU so does not pass the USACE dominance test for wetland vegetation.
Site 3, Hale Creek @ Rosita	10/14/2020	Exotic Tree	Exotic Tree	Not Likely	Same as above re: coast live oak, which is one of the dominant trees at this site. Other dominant species are Not Listed or FACU and do not pass the USACE dominance test for wetland vegetation. In addition, the concrete-lined likely cuts of channel hydrology from the vegetation growing alongside it.
Site 4, Thompson Creek @ Yerba Buena Ave	10/14/2020	Coast Live Oak Woodland w/ Exotic Component	Coast Live Oak Woodland	Not Likely	Same as above re: coast live oak. At this site, plot is adjacent to creek with flowing water in channel (trickle) with narrow band of freshwater wetland vegetation. Other dominant species, Eucalyptus, is Not Listed as wetland indicator species, but closes related species is Red River gum eucalyptus that is rated facultative. If eucalyptus is considered FAC, tree layer passes USACE

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
					dominance test, but the shrub layer does not.
Site 7, Adobe Creek @ El Camino #1	10/20/2020	Coast Live Oak Woodland	Coast Live Oak Woodland	Likely	Same as above re: coast live oak. Associated species in the plot, California buckeye and thorny olive, are Not listed. Other species of Elaeagnus (olive) are considered FAC in the Arid West. Even if thorny olive is considered FAC the site does not pass the USACE dominance test for wetland vegetation.
Site 8, Matadero @ El Camino	10/20/2020	Exotic Tree	Exotic Tree	Not Likely	At this site dominant trees and shrubs are Not Listed, FACU or UPL, and do not pass the USACE dominance test for wetland vegetation. This is a concrete lined channel and, as such, vegetation on the terrace above channel is cut off from channel hydrology.
Site 9, San Francisquito @ Maple	10/20/2020	Coast Live Oak Woodland	Coast Live Oak Woodland	Likely	Same as above re: coast live oak. At this site, plot was close to channel with willows on creek edge and oaks on the upper slope. There were three dominant tree and shrub species in the plot, 1 Not Listed, 1 FACW, and 1 FACU. With co-occurring willow and location close to creek, vegetation is likely a GDE.
Site B1, Palo Alto Baylands	10/20/2020	Tidal Marsh	Coyote Brush Shrubland	Likely	Coyote brush is listed by TNC as a California phreatophyte, although it is not listed as a wetland indicator species in the Arid West. While Kidder PhD says "Dry season xylem waters for adult B. pilularis plotted near groundwater, indicating these plants likely relied on deeper water sources" many of our regional occurrences of this species do not indicate shallow groundwater and would likely be tolerant of groundwater table declines. This area, however, is in a muted tidal wetland area, and the co-occurring species pass the USACE dominance test for wetland vegetation.

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
Site B2, Mountain View Shoreline Park	10/20/2020	Tidal Marsh	Pickleweed salt marsh	Likely	The dominant species in this marsh are dependent on surface water inundation from the tides and very shallow groundwater. As such, while it may be a GDE, this vegetation type is not a good indicator of deeper groundwater basin conditions.
Site 10A, Saratoga Creek @ Bollinger #1	10/20/2020	Mixed Riparian Woodland	Arroyo Willow Shrubland	Likely	The dominant species at this site are known to be dependent on surface water and shallow groundwater and pass the USACE dominance test for wetland vegetation.
Site 10B, Saratoga Creek @ Bollinger #2	10/20/2020	Coast Live Oak Woodland	Sycamore-Coast Live Oak Woodland	Likely	Same as above re: coast live oak. At this location coast live oak co-occurs with sycamore and willows which are phreatophytes with wetland indicator statuses. If coast live oak is excluded (since it is Not Listed as a wetland indicator species) this plot passes the USACE dominance test for wetland vegetation.
Saratoga Creek @ Cox Road	10/21/2020	Sycamore Woodland	California Buckeye	Likely	The dominant tree at this site - CA buckeye - is not listed as a CA phreatophyte by TNC, nor as a wetland indicator species by USACE, nor considered a regional indicator of wetlands or groundwater presence (although there is anecdotal evidence that CA buckeye tap into groundwater when available). Half of the dominant trees and shrubs at this site, however, are facultative or facultative-wetland indicator species, therefore passing the USACE dominance test (50/20 rule) for wetland vegetation.

Notes:

1) GDE determinations are based the Vegetation Rapid Assessment and TNC guidance, including the dominant plant species and the wetland indicator status of those species and other documented associations with groundwater. Determinations do not distinguish between shallow and deeper groundwater dependence, although such distinctions are mentioned in the notes as relevant. Determinations also do not consider depth to groundwater or whether a channel flow regime is natural or managed for groundwater recharge, although managed flows of sufficient duration and frequency could support GDEs that may not have occurred under pre-managed flow conditions.

2) United States Army Corps of Engineers (USACE) wetland plant indicator status categories used in some descriptions are as follows:
OBL = Obligate Wetland Plants: Plants that occur almost always (estimated probability >99%) in wetlands in natural conditions but may also occur rarely in (estimated probability <1%) in non-wetlands.
FACW = Facultative Wetlands Plants: Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands
FAC = Facultative Plants: Plants with similar likelihood (estimated probability of 33% to 67%) of occurring in wetlands and non-wetlands
FACU = Facultative Upland Plants: Plants that occur sometimes in wetlands (estimated probability 33% to 67%) but occur more often (estimated probability >67% to 99%) in non-wetlands
UPL = Obligate Upland Plants: Plants that occur rarely in wetlands (estimated probability <1%), but occur almost always (estimated probability >99) in non-wetlands under natural conditions

Table 6. Field Verification Sites and Outcomes in Laguna Seca and Llagas Subbasins. (Note – Site numbers refer to Figures 22 and 23).

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
Site 1A - wetland midway down channel adjacent to Fisher Creek Bypass	3/2/2021	Coastal and valley freshwater marsh	Cattail marsh	Likely	Cattail is listed as a CA phreatophyte and site passes the USACE dominance test for wetland vegetation. The dominant species requires surface and shallow groundwater; it does not rely on deeper groundwater. Standing water was present at the time of site visit.
Site 1B - south end of channel	3/2/2021	Willow riparian scrub/ freshwater marsh	Arroyo willow shrubland	Likely	The dominant species at this site are known to be dependent on surface water and shallow groundwater and pass the USACE dominance test for wetland vegetation. Standing water was present at the time of site visit.
Site 2 - Fisher Creek Bypass	3/2/2021	Willow riparian scrub/ freshwater marsh	Arroyo willow shrubland	Likely	The dominant species at this site are known to be dependent on surface water and shallow groundwater and pass the USACE dominance test for wetland vegetation. Standing water was present at the time of site visit.
Site 3A - triangular feature	3/2/2021	Potential seasonal wetland	Nonnative herbaceous (would need to revisit later in year to determine more specific vegetation type)	Unlikely	Plot was dominated by nonnative weeds including Dittrichia graveolens (NL), Conium maculatum (FACW), Cirsium vulgare (FACU), Baccharis pilularis (NL), and an unknown mustard. Soil was very dry, although it may get wet during wet years. Dominant weedy species and soil conditions are not indicative of an ecosystem dependent on groundwater. Since most species do not have listed wetland indicator statuses, a USACE dominance test for wetland vegeation could not be performed (or would not be passed).
Site 3B – channel	3/2/2021	Mixed riparian forest and woodland	Cottonwood forest and woodland	Likely	Fremont cottonwood is listed as a CA phreatophyte and the site passes the USACE dominance test for wetland vegetation. Saturated soils and standing water were observed at the time of site visit.
Site 4	3/2/2021	Hay and pasture	Hay and pasture	Unlikely	It was too early in the season to identify many plants to species level, therefore a wetland vegetation dominance test could not be performed. However, field is an active pasture for cattle and dominated by nonnative grasses, mustard, dock, thistles, and other nonnative herbaceous plants that

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
					are not considered CA phreatophytes or otherwise dependent on groundwater.
Site 5 - tributary of Fisher Creek	3/2/2021	Coastal and valley freshwater marsh	Arroyo willow shrubland	Likely	The dominant species at this site are known to be dependent on surface water and shallow groundwater and pass the USACE dominance test for wetland vegetation. Flowing water was present at the time of site visit.
Site 6	3/2/2021	Coastal and valley freshwater marsh	Coastal and valley freshwater marsh	Likely	Coastal and valley freshwater marsh species are considered CA phreatophytes and the site passes dominance test for wetland vegetation. The dominant species require surface and shallow groundwater; they do not rely on deeper groundwater. Saturated soil conditions were observed at the time of site visit.
Site 8	3/2/2021	Hay and pasture	Hay and pasture	Unlikely	Site was observed from the adjacent road. Vegetation appears to be dominated by mustard and nonnative grasses, which are not CA phreatophytes or otherwise associated with shallow or deeper groundwater.
Site 9	3/2/2021	Mixed riparian forest and woodland	Cottonwood forest and woodland	Likely	Fremont cottonwood is listed as a CA phreatophyte and the site passes the USACE dominance test for wetland vegetation. Standing water was observed at the time of site visit. [Site has little vegetative cover, determined to be Cottonwood forest and woodland based on limited cover of two cottonwood individuals, willow, and coyote brush along the channel (not pictured).]
Site 10 - Coyote Creek downstream of Burnett Avenue	2/17/2021	Fremont cottonwood forest with red willow	Red willow forest and woodland	Likely	Red willow is listed as a CA phreatophyte by TNC and the site passes the USACE dominance test for wetland vegetation. The site is downstream of Anderson Dam, where flow releases may help support more wetland and riparian vegetation than may have occurred pre-dam.
Site 11 - Foothills between Hwy 101 and Ogier Ponds	Desktop assessment	Mixed oak woodland and California annual grassland;	Iron bark eucalyptus woodland	Unlikely	The dominant species and landscape position (gently sloped hillside) are not indicative of groundwater dependence. There are relatively narrow drainage swales originating from culverts under Highway 101, and that are intercepted by Coyote

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
		seasonal wetland is mapped nearby (VHP)			Canal, that may be groundwater dependent. Topography and aerial imagery interpretation can be used to estimate the boundaries of the seasonal wetland swales.
Site 12 - Llagas Creek @ Buena Vista Street	2/17/2021	Eucalyptus	Glue gum eucalyptus woodland	Likely	Glue gum eucalyptus is the dominant tree at this site, which is listed by TNC as a CA phreatophyte. Regional distribution patterns of eucalyptus, which are typically along waterways, as well as occasional western sycamore at the site, suggests groundwater dependence.
Site 13 - West Little Llagas Creek @ Main	2/17/2021	Exotic Trees	Mixed oak woodland	Likely	Dominant trees in this plot were valley oak and coast live oak. Coast live oak is listed as a CA phreatophyte by TNC, and US Forest Service says "Several deep main roots may tap groundwater if present within approximately 36 feet (11 m) of the soil surface. Coast live oak develops extensive horizontal root branches and surface-feeding roots." This species often grows near creeks, where it is likely groundwater dependent, but farther away it is not. It is not listed as a wetland indicator species by USACE. As such, stands of this species alone should not be used to define GDEs unless in known shallow aquifer, near a waterway, and/or growing with other phreatophytes. Valley oak is listed by TNC as using deep groundwater but is not considered a wetland species (FACU). The site did not pass the USACE dominance test or prevalence index for wetland vegetation, but the presence of coast live oak and valley oak, along with red willow (FACW) and walnut (FAC) suggest this is a GDE.
Site 14 - Church Creek	2/17/2021	Mixed riparian	Valley oak riparian	Likely	Valley oak is the dominant tree at this site, which is listed by TNC as using deep groundwater.
Site 15 - Carnadero Creek @ Princevalle	2/17/2021	Sand bar willow thicket	Riparian wash/scrub	Likely	Site does not include any trees. Dominant species—mulefat, mugwort, willow, and ash—are listed by TNC as CA phreatophytes and site passes the USACE dominance test for wetland vegetation. Dominant species are all indicative of riverine wetland habitats and use surface water and shallow

Site Number and Name	Date Surveyed	Mapped Vegetation Type	Field-Assessed Vegetation Type	Is it a GDE?[1]	GDE Determination Notes
					groundwater. The site is downstream of Uvas Reservoir, where flow releases may help support more wetland and riparian vegetation than may have occurred pre-dam.

Notes:

1) GDE determinations are based the Vegetation Rapid Assessment and TNC guidance, including the dominant plant species and the wetland indicator status of those species and other documented associations with groundwater. Determinations do not distinguish between shallow and deeper groundwater dependence, although such distinctions are mentioned in the notes as relevant. Determinations also do not consider depth to groundwater or whether a channel flow regime is natural or managed for groundwater recharge, although managed flows of sufficient duration and frequency could support GDEs that may not have occurred under pre-managed flow conditions.

2) United States Army Corps of Engineers (USACE) wetland plant indicator status categories used in some descriptions are as follows:
OBL = Obligate Wetland Plants: Plants that occur almost always (estimated probability >99%) in wetlands in natural conditions but may also occur rarely in (estimated probability <1%) in non-wetlands.
FACW = Facultative Wetlands Plants: Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands
FAC = Facultative Plants: Plants with similar likelihood (estimated probability of 33% to 67%) of occurring in wetlands and non-wetlands
FACU = Facultative Upland Plants: Plants that occur sometimes in wetlands (estimated probability 33% to 67%) but occur more often (estimated probability >67% to 99%) in non-wetlands
UPL = Obligate Upland Plants: Plants that occur rarely in wetlands (estimated probability <1%), but occur almost always (estimated probability >99) in non-wetlands under natural conditions
NL = Not Listed

3.3.1. GDE Map Agreement with Field Verification of GDEs

The field inspections at the 34 verification sites provided independent data to evaluate the ability of the final GDE map (Figure 17) to accurately identify GDEs. The results from each field verification site (likely or unlikely a GDE, Tables 5 and 6) were compared to the GDE designated in the final map (Figure 17). Over 90% of the verification sites agreed with the final GDE map, which indicate a very high agreement between the map and independent site data. Based on these results, the final GDE map (Figure 17) has a relatively high ability to accurately identify GDEs in the Santa Clara and Llagas subbasins.

3.3.2. Phreatophytes in Areas of Deep Groundwater

The field verification at some sites identified phreatophytes that are normally indicative of shallow groundwater but were in areas of deep groundwater (greater than 50 feet) in the subbasins, including along some stream reaches that are not influenced by Valley Water reservoir operations. The phreatophytes in these locations may be supported by water sources other than groundwater. The phreatophytes at these sites largely consists of Coast Live Oak, Eucalyptus, Red Willow, and the category *'exotic tree canopy'* that would be classified as "unlikely" groundwater dependent based on rooting depth and DTW. These phreatophytes may be supported by stormwater from drains that empty into the streams. The source of this stormwater is unknown but may be associated with broken or leaking irrigation systems, draining of swimming pools, hydrant flushing, or groundwater dewatering projects. Two such examples are illustrated in Figures 24 and 25.

Figure 24 shows dense vegetation, hydric soils, and pooled water below a stormwater outfall on Saratoga Creek, downstream of Highway 280. Given the deep groundwater and location of the stormwater outfall,

this vegetation is not likely dependent on groundwater in the subbasin. The conditions at this location suggest that the storm drain may receive regular or periodic discharge. Figure 25 illustrates another site on Thompson Creek near Evergreen Community College (Site #4, Figure 21) that may give a false signal of groundwater dependence based solely on vegetation. This site is an area of deep groundwater but has a steady discharge from the stormwater outfall that may be from a nearby groundwater dewatering operation given the proximity of the project and lack of turbidity in the discharge. However, the exact source of water from this stormwater outfall is unknown.

Figure 24. Vegetation Near Stormwater Outfall on Saratoga Creek.

Figure 25. Vegetation Near Stormwater Outfall on Thompson Creek.

Former or periodic pipeline releases of imported water for recharge is another source of surface water that could sustain phreatophytes at some sites over deep groundwater areas. Pipeline releases can occur when imported surface water is plentiful as part of Valley Water's groundwater recharge operations. For example, periodic pipeline releases have occurred along Saratoga Creek between Highway 85 and Highway 280 (Figure 26), which overlies an area of deep groundwater (DTW greater than 50 feet). During the field verification in June 2020, there was no visual evidence of shallow groundwater. However, the

Vegetation Rapid Assessment identified Sycamore woodland (left photo) and arroyo willow shrubland (right photo) (Figure 26), which indicates these sites are likely groundwater dependent. Given that DTW at this site is greater than the typical rooting depth, the vegetation at this site may be supported by infrequent or discontinued pipeline releases during recharge operations. Once established, vegetation may take some time to revert to a natural state.

Figure 26. Phreatophytes Along Saratoga Creek Between Highway 85 and Highway 280.

3.3.3. Added GDE Polygon Features in Coyote Valley

The northern part of Coyote Valley, where bedrock features (Tulare Hill) form a subsurface barrier to groundwater flow, is known as Laguna Seca (Figure 27). The bedrock features often cause groundwater to emerge at land surface during the wet season and generally create year-round shallow groundwater conditions in Laguna Seca. Consequently, this area was a vast wetland habitat in pre-development times. In the early 1900s, a system of tile drains was installed to create arable soil conditions for farming. More recent activity has further modified the natural drainage patterns in the area creating the Fisher Creek bypass channel and associated dam. These modifications to the drainage pattern have created groundwater conditions that support GDEs, which is why new GDE polygons were added to this area (Figure 27). This is the only area in the Santa Clara and Llagas subbasins that required additional GDE features to the final GDE map (Figures 17 and 28). These additional GDE features were not identified on the phreatophytes maps (Figure 7). The added GDE polygons were field verified and approved as GDEs by Valley Water biologists, as shown in Figure 26. The added GDE polygons shown in Figure 26 are included in the final GDE map (Figure 17).

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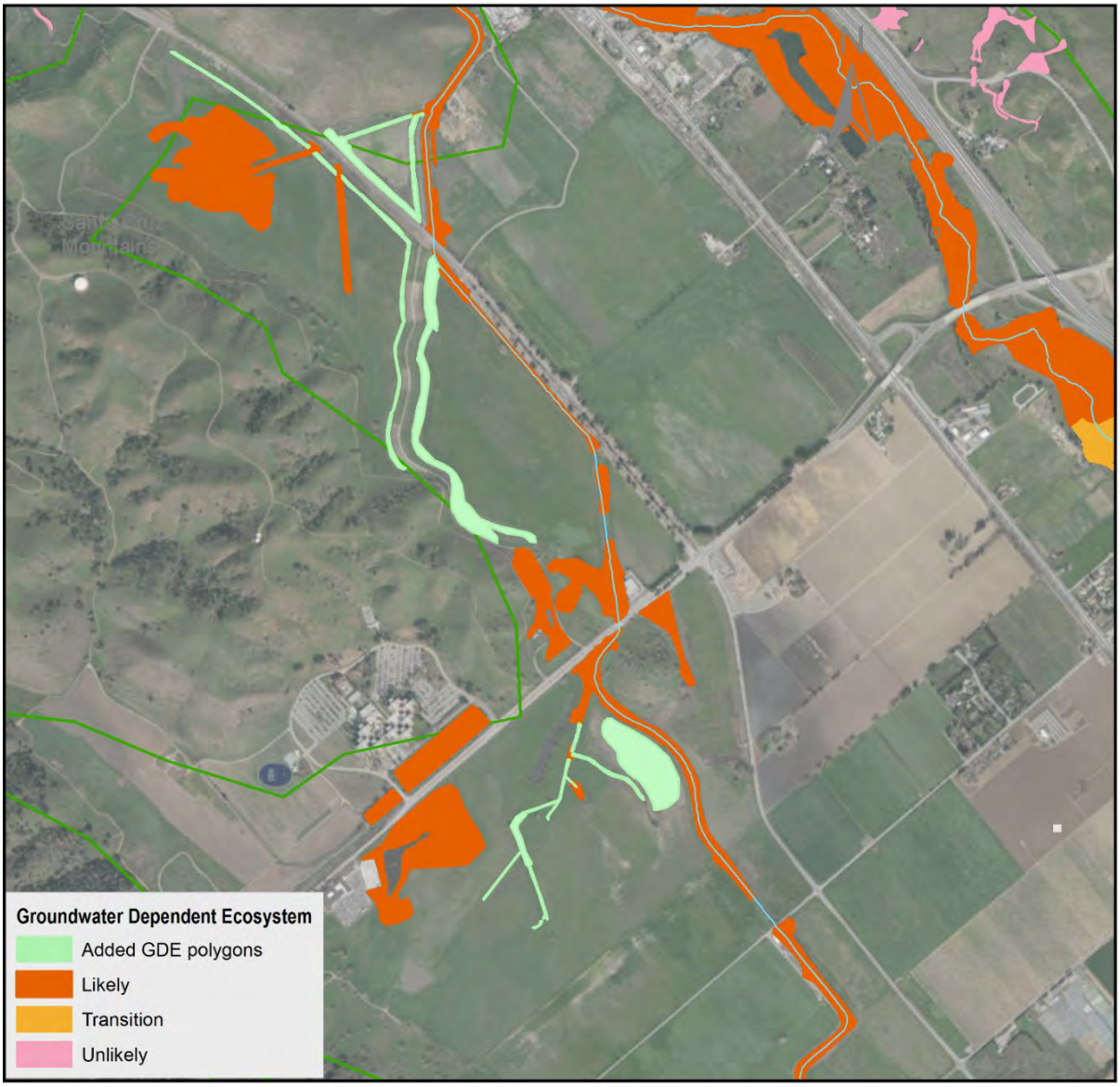
Figure 27. Added GDE Polygon Features in the Laguna Seca Areas of Coyote Valley.



3.4. Final Field Verified GDE Maps

The final field verified GDE maps for the Santa Clara and Llagas subbasins are shown in Figure 28 and 29, respectively. Figures 28 and 29 show the same GDEs as Figure 17, but also include the associated DTW water categories. Figures 28 and 29 will be shown in the 2021 GWMP update to characterize the GDEs in the Santa Clara and Llagas subbasins. It is important to note that due to the large scale DTW map presented in Figures 28 and 29, some GDEs appear to have mislabeled categories (likely, transition, and possible) based on DTW ranges. For example, on the western side of the Santa Clara Plain, Figure 28 appears to incorrectly show that many transition GDEs overly DTW greater than 50 feet. Although not shown in this memo, a zoomed in version of Figures 28 and 29 would indicate that all GDE categories

overly the correct DTW range based on Table 3. For example, at a zoomed in map scale, the transition GDEs on the western side of the Santa Clara Plain correctly overly DTW 30–50 feet.

Figure 28. Field Verified GDEs and Depth to Water in the Santa Clara Subbasin.

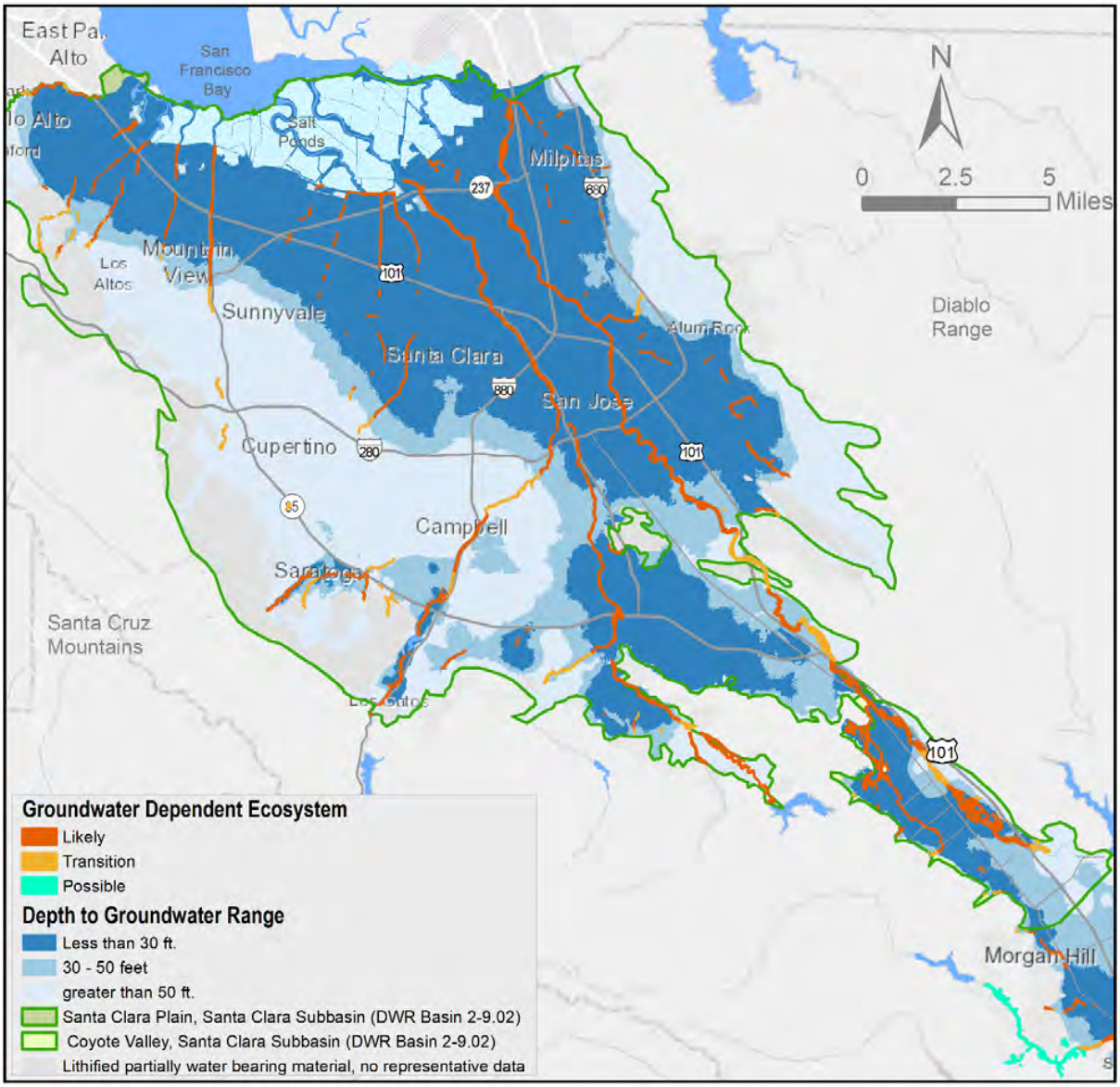


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Figure 29. Field Verified GDEs and Depth to Water in the Llagas Subbasin.

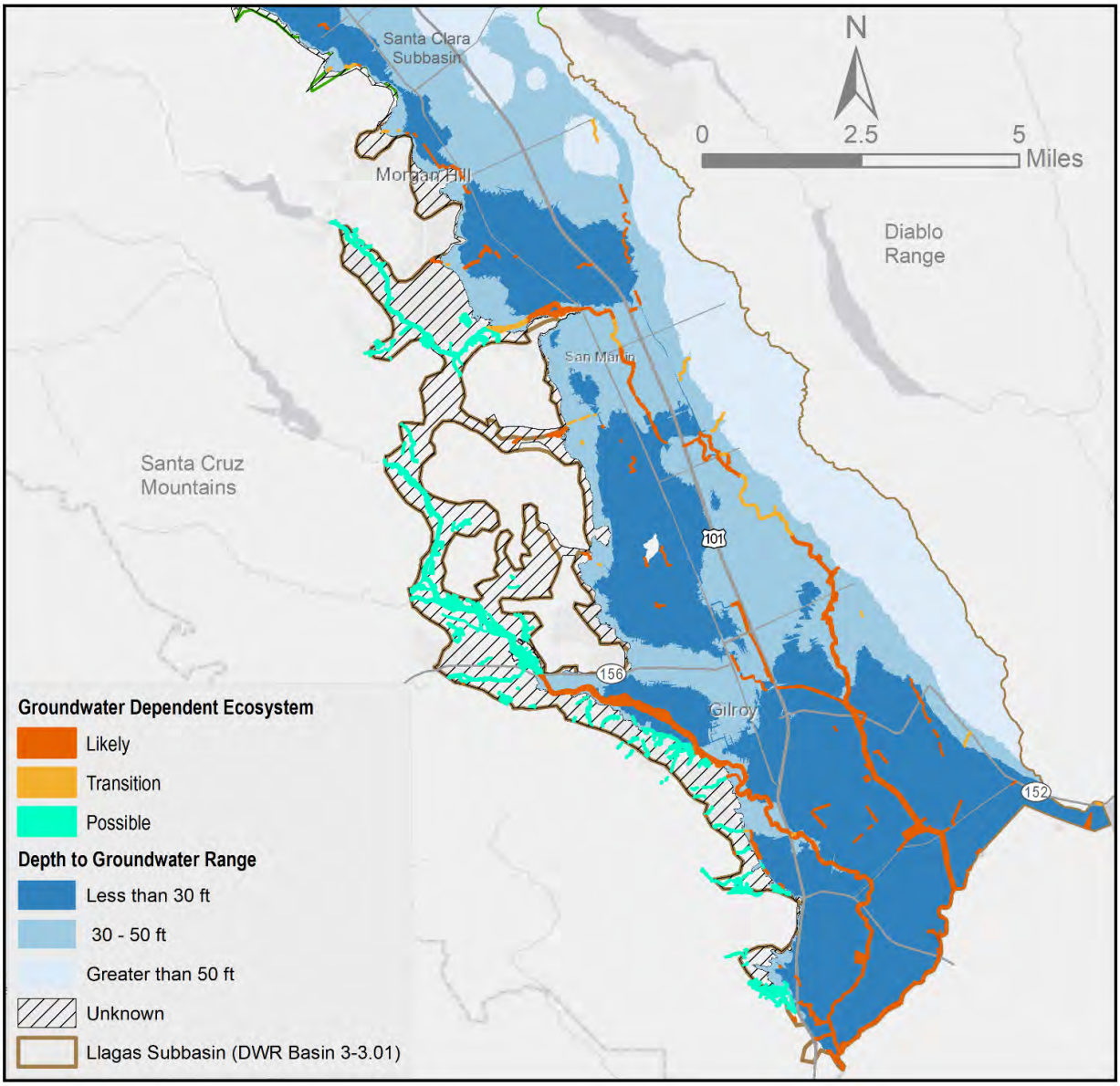

Table 7 summarizes the area of GDEs in each of the groundwater management areas within the Santa Clara and Llagas subbasins. The greatest area of likely GDE and transition GDE categories are in the Santa Clara Plain (3,303 acres), followed by the Llagas Subbasin (1,707 acres) and the Coyote Valley (851 acres) groundwater management areas (Table 7). Although Coyote Valley has the smallest GDE area, it has largest density of GDEs given its smaller overall area compared to the other two groundwater management areas. The Santa Clara Plain has the greatest area of transition GDE category because of the relatively large DTW in many parts of the Santa Clara Plain. The Llagas Subbasin has a relatively high percentage of possible GDEs, which supports the need for future evaluations of the possible GDEs, as described in the next section.

Table 7. GDE Acres in each Groundwater Management Area based on Figures 27 and 28.

GDE category	Santa Clara Subbasin		Llagas Subbasin (acres)	Total (acres)
	Santa Clara Plain (acres)	Coyote Valley (acres)		
Likely GDE	2,682	744	1,600	5,026
Transition	621	170	107	898
Possible GDE	0	0	1,340	1,340
Total GDE (acres)	3,303	914	3,047	7,264

3.5. Data Gaps and Limitations

While DTW is mapped across most areas of the subbasins, there are some small areas where groundwater elevation data is unavailable, including the western areas of the Llagas Subbasin (Figure 30). Specifically, the narrow canyon areas along the western edge of the Llagas Subbasin are not currently part of Valley Water's groundwater level monitoring program because these areas were historically considered part of the bedrock terrain. Therefore, groundwater elevation data is unavailable to map DTW in these areas (Figure 30). The result is that the Llagas Subbasin has 1,340 acres of possible GDEs, which is a relatively large ratio compared to likely GDEs and transition categories (Table 7).

Well sealing requirements and local conditions often require wells screens be set in deeper bedrock formations bypassing the shallow alluvial aquifers. Therefore, local de-minimis pumping (i.e., small groundwater pumping typical of domestic wells) would be expected to have little or no effect on possible GDEs along the reservoir supported creeks in these western areas of the Llagas Subbasin. Additionally, the two main streams (Llagas and Uvas-Carnadero creeks) are supplied by reservoir releases throughout the summer months as part of the Valley Water's managed recharge program, which further reduces the effects of localized pumping on these small areas of the subbasin. Further evaluation of these areas along the Llagas and Uvas-Carnadero creeks is needed to determine if additional groundwater level monitoring is necessary to more definitely categorize the possible GDEs in the Llagas Subbasin.

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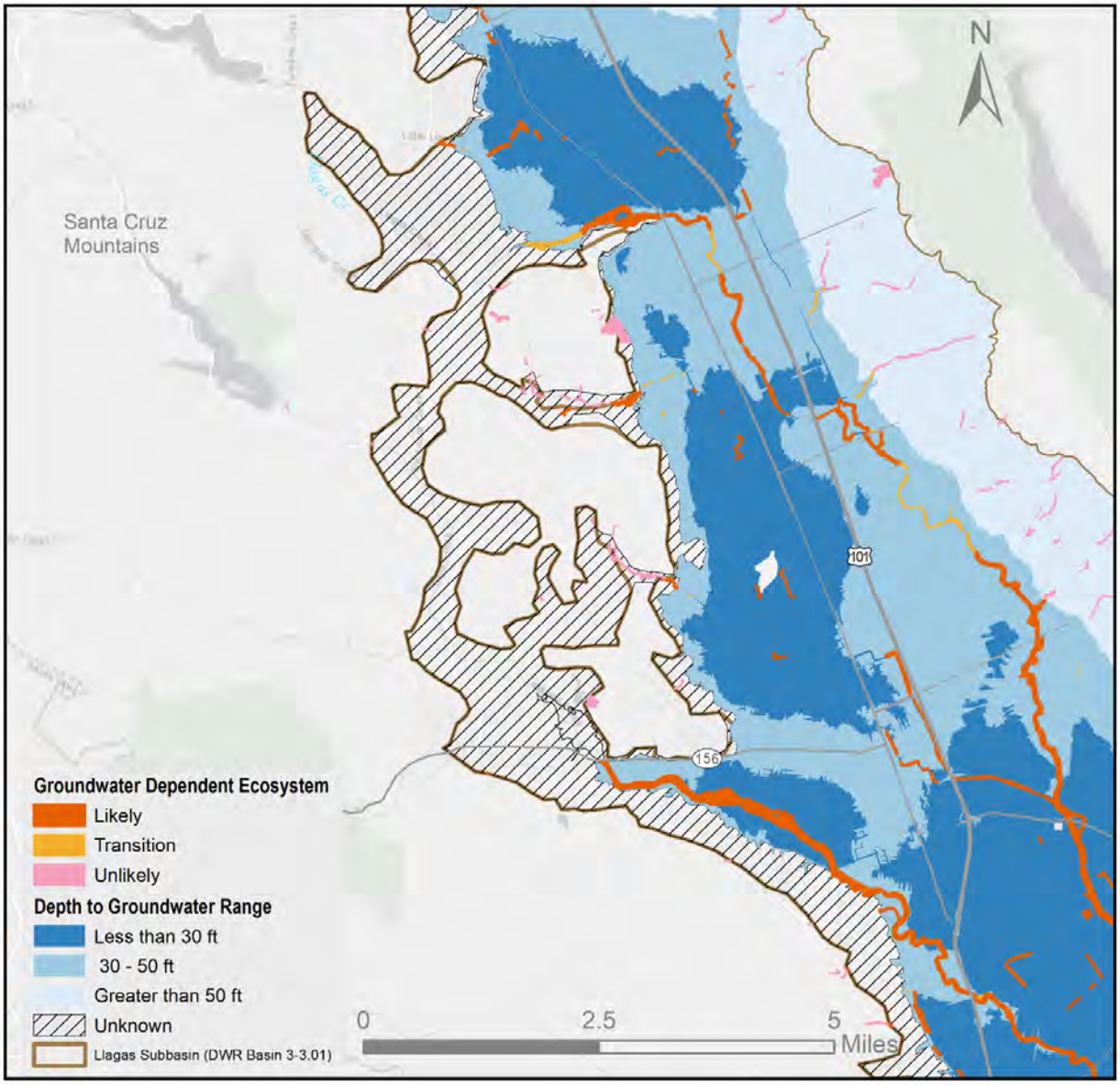
Figure 30. Areas of Llagas Subbasin with Little to No Groundwater Elevation Data.



4. Acknowledgements

This study was completed with support from many Valley Water units and staff. In particular, we thank Valley Water biologists Doug Titus, Zooey Diggory, and Claire Mallen (Environmental Mitigation and Monitoring Unit) for their extensive and expert contributions to identify California phreatophytes and rooting depths, conduct the field surveys, and provide guidance throughout the study. We also thank the nearly two dozen Valley Water staff from the Water Utilities and Watershed divisions that participated in the internal GDE stakeholder meetings and review process of the GDE maps for their construction comments and feedback. Finally, we thank Open Space Authority (OSA) and Peninsula Open Space Trust (POST) for allowing access to their land for the field surveys.

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APPENDIX H

TECHNICAL MEMORANDUM

SEAWATER INTRUSION OUTCOME MEASURE AND CONCEPTUAL MODEL OF SEA LEVEL RISE IMPACTS ON GROUNDWATER FOR THE 2021 GROUNDWATER MANAGEMENT PLAN

Prepared by:

Jason Gurdak, Ph.D., P.H.

Senior Water Resources Specialist

and

Randy Behrens, P.G.

Assistant Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.

Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

October 2021

Executive Summary

This technical memorandum documents the development of a new seawater intrusion (SWI) outcome measure (OM) to be included in the 2021 Groundwater Management Plan (GWMP). The development of a SWI OM is one of five Recommended Actions by California Department of Water Resources (DWR) in their review of the 2016 GWMP, which is the Alternative to the Groundwater Sustainability Plan [Alternative] that was submitted to DWR by Valley Water in 2017. Therefore, the primary purpose of this memorandum is to document the conceptual model of SWI mechanisms, analysis, and results that were used to develop the SWI OM and associated outcome measure-lower threshold (OM-LT). This memorandum relates only to the northern Santa Clara Subbasin (Santa Clara Plain groundwater management area), which is adjacent to San Francisco Bay. SWI and SLR are not relevant for the inland Coyote Valley groundwater management area of the Santa Clara Subbasin or the Llagas Subbasin.

SWI intrusion has been observed in shallow aquifers of the Santa Clara Subbasin near San Francisco Bay, primarily due to the leakance of saltwater beneath tidal creeks (especially the Guadalupe River and Coyote Creek). Classic SWI, where seawater and aquifer are in direct hydraulic connection, is constrained by local hydrogeology, which includes thick deposits of Bay mud with very low hydraulic conductivity.

The analysis described in this memo resulted in the following new SWI OM: In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter (mg/L) chloride isocontour area is less than the historical maximum extent area (57 square miles). The new OM-LT is: In the Santa Clara Subbasin shallow aquifer, the 100 mg/L chloride isocontour area is less than 81 square miles, which represents a one-mile radial buffer of the historical maximum extent area.

This memorandum also documents the current understanding of climate change driven sea-level rise (SLR) and implications for monitoring and managing of the SWI OM in the Santa Clara Subbasin. SLR may increase SWI short distances inland from the Bay. However, the Bay mud is likely to mitigate some effects of groundwater shoaling and emergence in areas of the semiperched groundwater table. Studies that assume unconfined aquifer conditions and connectivity between the Bay and adjacent aquifers and neglect the very low hydraulic conductivity of the Bay mud are likely to overestimate the magnitude and extent of SLR-driven groundwater emergence of the northern Santa Clara County aquifer systems.

To prevent undesirable results stemming from SWI, it is imperative to avoid returning to the historical (pre-1970s) groundwater overdraft and pumping conditions that causes the subsidence and reversal of the natural hydraulic gradient in groundwater toward the Bay. Additional monitoring and studies are needed to better understand the connection between Bay water, semiperched groundwater, and the shallow aquifer zone to more accurately project SWI and SLR-driven groundwater emergence. Major findings from this memorandum will be summarized in the 2021 GWMP.

1. Introduction

Under California's 2014 Sustainable Groundwater Management Act (SGSM), seawater intrusion (SWI) is one of the six sustainability indicators (DWR, 2017). Sustainability indicators are defined as the "effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, became undesirable results" (DWR, 2017). The relevant undesirable result here is "Significant and unreasonable seawater intrusion". Under SGMA, "significant and unreasonable conditions" are the conditions documented by the GSA in which the sustainability indicator(s) becomes significant and unreasonable in their basin, including the reason for justifying each particular threshold selected. The evaluation of significant and unreasonable conditions should identify the geographic area

over which the conditions need to be evaluated so the GSA can choose appropriate representative monitoring sites (DWR, 2017).

1.1. Seawater Intrusion (SWI) and Sea-Level Rise (SLR)

Seawater intrusion (SWI) refers to the transient or permanent flux of seawater (or saltwater) into coastal freshwater aquifers. SWI is synonymous with the term saltwater intrusion. SWI is a groundwater management concern because it can degrade groundwater quality and, if severe enough, result in significant and unreasonable conditions that may include limiting groundwater as a water supply for municipal and industrial uses, agriculture, and domestic uses, or degrading groundwater dependent ecosystems (GDEs) or infrastructure. Reclaiming freshwater aquifers after SWI is very costly and time-consuming, if not practically infeasible in many cases. Therefore, sustainable groundwater management actions and policy choices that prevent or mitigate SWI are preferred to costly SWI remediation.

SWI can occur to varying degrees in either unconfined or confined aquifers and can be the result of anthropogenic (human) or natural processes. Anthropogenic causes of SWI are associated with groundwater overdraft and lowering of groundwater levels in coastal aquifers (Figure 1) and sea-level rise (SLR) associated with climate change. Figure 1 illustrates the so-called "classic" case of SWI where groundwater pumping and overdraft lowers the water table and allows saline groundwater (often called the saltwater wedge) to flow inland and displace fresh groundwater. Another potential cause of anthropogenic SWI is the disturbance or bypassing of natural geologic barriers that formerly prevented the migration of seawater. This could result from removing or boring through low-permeability geologic materials during construction activities or from improperly constructed or destroyed wells acting as vertical conduits. Climate change over geologic timescales not associated with human activities also caused SWI. However, this type of natural SWI is not currently a process that is relevant for sustainable groundwater management of coastal aquifers.

This memorandum evaluates anthropogenic causes of SWI, including SLR associated with future climate change that is projected over the 21st century. Consistent with many other SWI and SLR studies and DWR SGMA guidance (DWR, 2017), Valley Water uses the 100 mg/L chloride isocontour in groundwater as an early warning indicator of SWI. The 100 mg/L chloride isocontour is also a conservative (i.e., lower) indicator because the Secondary Maximum Contaminant Level (SMCL) for chloride in drinking water is 250 mg/L. Chloride is also an ideal tracer of SWI from a geochemical perspective because it is a geochemically conservative (i.e., unreactive) ion that is primarily influenced by the mixing of freshwater and saltwater, and not influenced by other sorption or replacement geochemical reactions that can affect other ions in seawater. Additionally, it should be noted that the actual threshold between non-affected groundwater and SWI probably is less than 100 mg/L chloride concentration (Iwamura, 1980).

Valley Water's 2016 GWMP notes that a historical cause of SWI in the shallow aquifer of the Santa Clara Subbasin was high groundwater pumping and land subsidence, particularly in the years following World War II (Valley Water, 2016). SWI in the shallow aquifer is also attributed to the tidal incursion of San Francisco Bay water within the tidal reaches of creeks and subsequent transport to shallow groundwater through streambed percolation, improperly abandoned wells, cathodic protection wells, and other vertical conduits (Valley Water, 2016). This mechanism was exacerbated by land subsidence, which caused tidal incursion to extend further inland due to permanent changes in the land surface. These SWI mechanisms are described in additional detail in the conceptual model section below.

The 2016 GWMP notes that historical SWI affected only a small portion of the principal aquifer zone and that chloride concentrations have been relatively low. Inter-aquifer transfer from the shallow to principal aquifer zones through improperly sealed or destroyed wells was a likely mechanism for SWI in the principal aquifer (Valley Water, 2016). The 2016 GWMP also stated that the monitoring network in the Baylands area adjacent to southern San Francisco Bay has limited coverage of the principal aquifer zone, which indicates the need for additional monitoring.

Figure 1A. Typical coastal unconfined aquifer outside Santa Clara County under natural conditions.

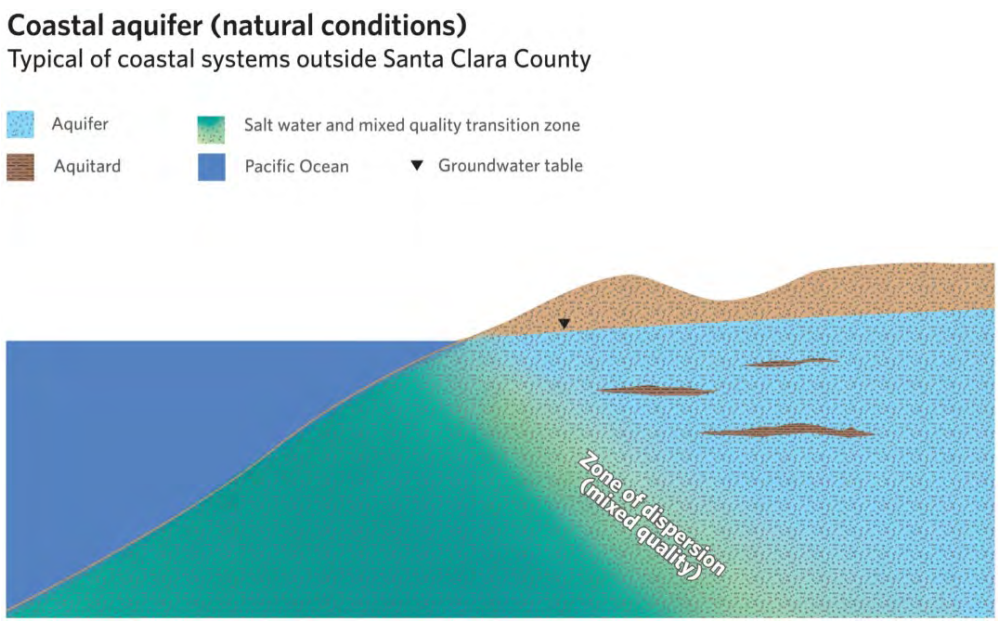
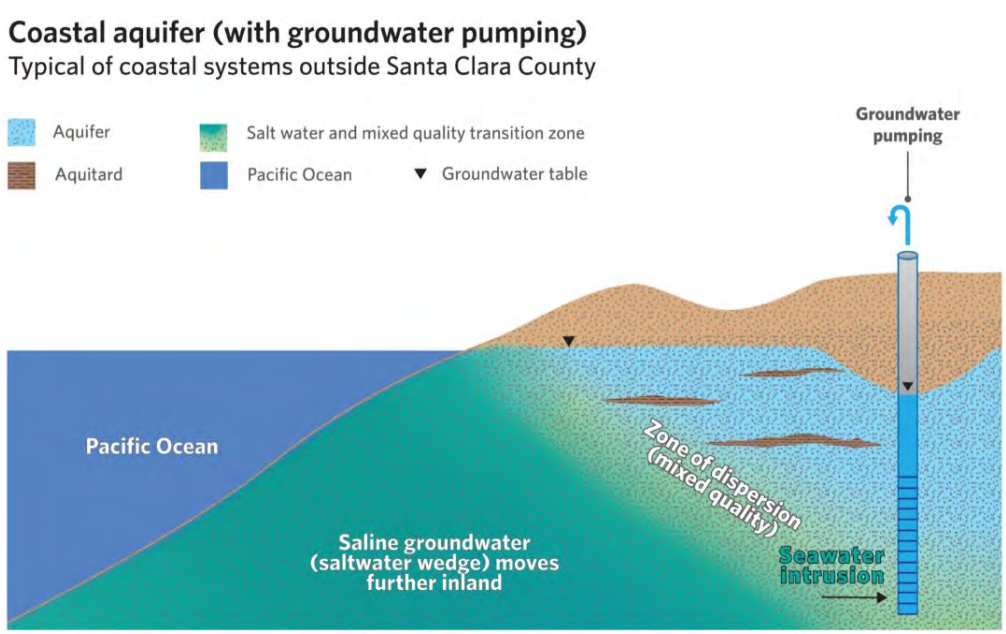


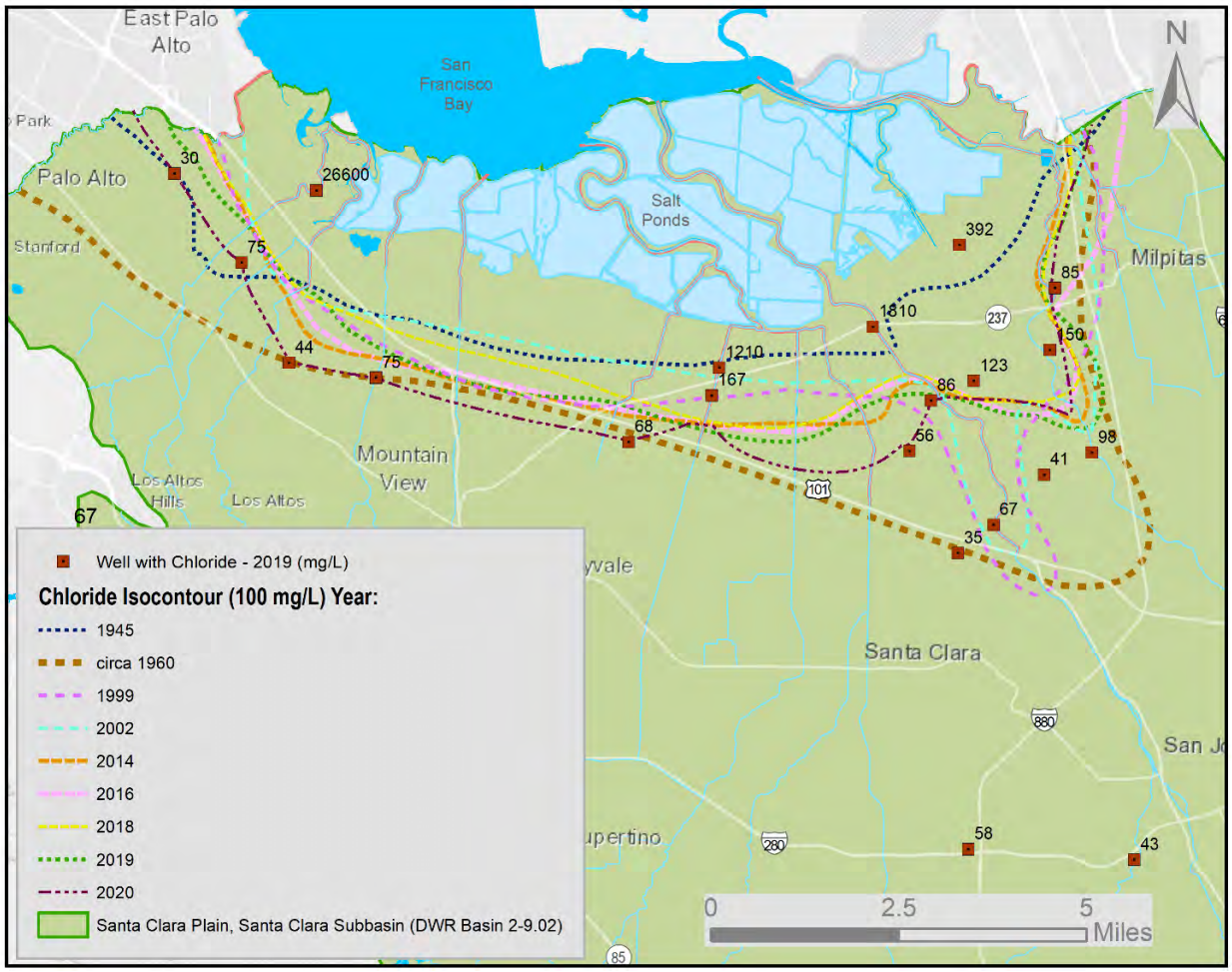
Figure 1B. Typical coastal unconfined aquifer outside Santa Clara County with seawater intrusion (SWI) caused by groundwater pumping.



1.2. Purpose and Scope

Valley Water's 2016 GWMP did not include a specific SWI outcome measure (OM) or discuss SLR. Instead, the Santa Clara Subbasin section of the 2016 GWMP used a map of SWI in the shallow aquifer zone of the Santa Clara Plain (Figure 2) to highlight that the maximum extent of SWI in 1960s (shown as the 1980 line on Figure 2) has been reduced as of 2015 and that SWI is a minimal threat to groundwater quality in the principal aquifer zone.

Figure 2. Extent of seawater intrusion during select years in the Santa Clara Plain shallow aquifer zone (taken from Figure 5-321 in the 2021 GWMP).



Note: The historical maximum extent of the 100 mg/L chloride isocontour occurred around 1960.

As context for addressing DWR's Recommended Action about the SWI OM, the GSP regulations contain specific requirements and metrics for each sustainability indicator, including the 'significant and unreasonable seawater intrusion' sustainability indicator.[1] As stated in DWR (2017), "the minimum threshold metric for SWI shall be the location of a chloride isocontour. Contrary to the general rule for

[1] Alternatives to GSPs, such as the 2021 GWMP, are not subject to the specific requirements for GSPs, but must demonstrate functional equivalency.

setting minimum thresholds, the SWI minimum threshold is not set at individual monitoring sites. Rather, the minimum threshold is set along an isocontour line in a basin or management area." The 2016 GWMP presented the SWI map (Figure 2) with 100 mg/L isocontours from 1945, 1960s, and 2015 in the basin setting section of the Santa Clara Subbasin but did not contain a SWI OM.

Therefore, the purpose of this memorandum is to document the conceptual model of SWI mechanisms, approach, analysis, and results that were used to develop the SWI OM and associated outcome measure-lower threshold (OM-LT). This memorandum also documents current understanding of climate change driven SLR and implications for monitoring and managing of SWI in the Santa Clara Subbasin. Valley Water has implemented numerous managed and in-lieu recharge activities to minimize the risk of groundwater overdraft, land subsidence, and SWI (Valley Water, 2020, see Appendix H-1). This memorandum concludes with several recommendations for continued recharge and monitoring programs.

2. Conceptual Models of Seawater Intrusion (SWI) and Sea-Level Rise (SLR)

SWI and SLR are complex processes that can vary considerably over space and time. This section describes Valley Water's conceptual models of SWI and SLR, including the current understanding of implications to the shallow and principal aquifer zones of the Santa Clara Subbasin. These conceptual models are based on results of long-term groundwater monitoring and previous studies conducted by Valley Water and related research and monitoring studies from other organizations. These conceptual models support subsequent decisions regarding the SWI OM and OM-LT, including the associated groundwater monitoring plan that will be summarized in the 2021 GWMP update.

2.1. Seawater Intrusion in the Santa Clara Subbasin

The study area where SWI monitoring is most relevant is the broad alluvial plain surrounding the southern extent of San Francisco Bay (Bay) shoreline contained within Santa Clara County from Palo Alto in the west to Milpitas in the east, extending south-southeast into Sunnyvale and Santa Clara (Figure 3). This area is referred to as the Santa Clara County Baylands (Baylands) and is the northern extent of the Santa Clara Subbasin. Salt evaporation ponds (Figure 3) are located adjacent to the Bay and are separated from the Bay and adjacent inland areas by levee systems. The study area shown in Figure 3 was the subject of a SWI monitoring evaluation by Valley Water (Figure 3) (Valley Water, 2020).

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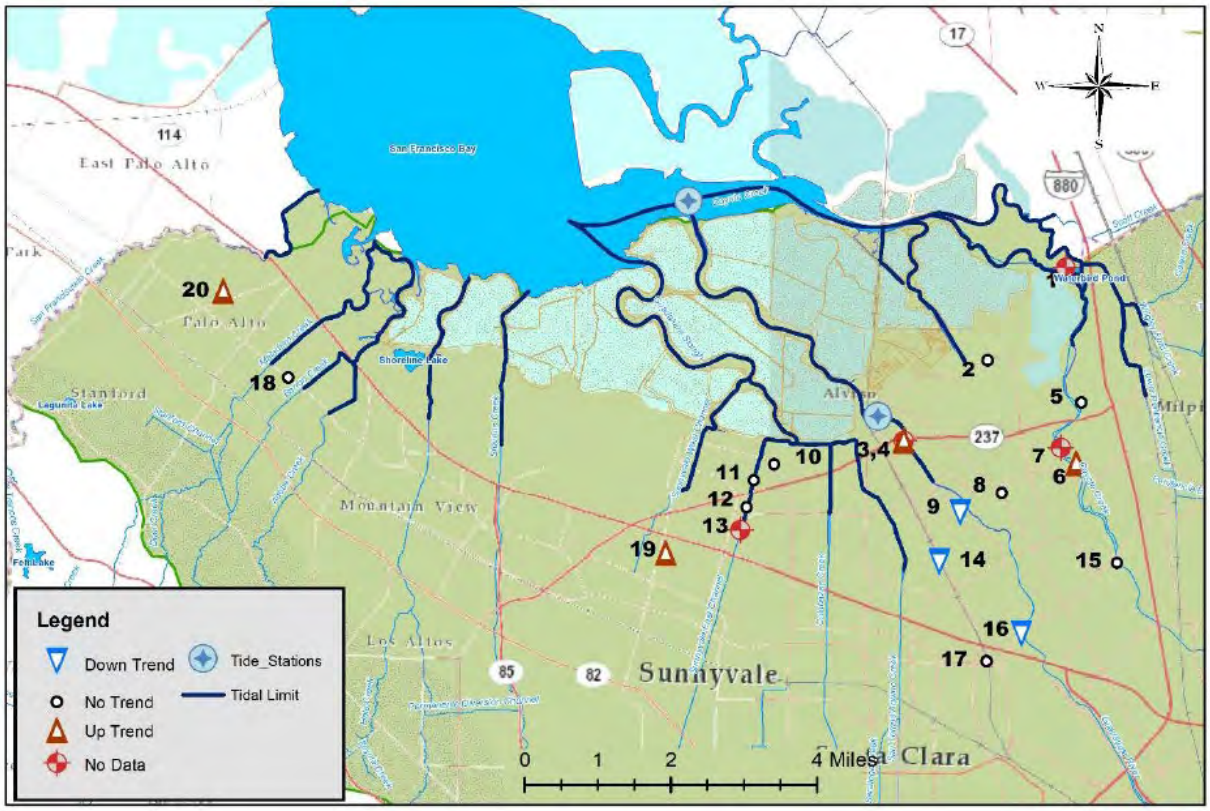
Figure 3. Location of the Baylands, including the tide stations and monitoring wells that were analyzed for tidal influence and (2019) chloride trends (Valley Water, 2020).



Note – Guadalupe shallow well (map ID – 3); Guadalupe deep well (map ID – 4).

2.1.1. Hydrologic, Geologic, and Hydrogeologic Setting

Average rainfall in the study area is about 13 inches per year and is markedly seasonal, with almost all rain falling between October and April each year. Several small ephemeral and perennial streams flow through the Baylands study area and drain directly into southern San Francisco Bay (Figure 3). The most prominent of these streams are Coyote Creek and the Guadalupe River. During flood events, these streams carry sediment from the adjoining highlands to the lowlands where it is deposited to form flat alluvial plains and estuarine mudflats. The study area consists of geologically young, unconsolidated material that form the very low relief terrain of the Santa Clara Plain (Helley and Lajoie, 1979). Geologic units in the study area consist of estuarine clay and silt and marsh deposits (collectively known as Bay mud), alluvial fan, channel, flood basin, and levee deposits. The low permeability Bay mud underlies the relatively shallow San Francisco Bay (average depth of 12 to 15 feet) and isolates the Bay from the underlying aquifers (Iwamura, 1980).

In the Santa Clara Plain, the alluvial sediments tend to be coarser and more permeable along the elevated edges of the basin, while finer and less permeable deposits tend to be found in the basin interior (Iwamura, 1980). The coarser (sand and gravel) materials make up the aquifers and the finer and nearly impermeable materials (silt and clay) make up the aquitards. The basin interior tends to have greater stratification of aquifer and aquitards, while the upper elevated edges of the basin have less stratification of aquitard materials (Figures 4 and 5). The recharge area refers to these elevated upper edges of the alluvial fan where there is less stratification and occurrence of aquitards, and groundwater occurs as one

unconfined aquifer (Iwamura, 1980). Valley Water's managed recharge program occurs in the unconfined recharge area of the Santa Clara Plain (Figure 4).

Figure 4. Santa Clara Subbasin recharge and confined areas, including the cross-sections A – A' and B – B' (taken from Figure 2-3 in the 2016 GWMP).

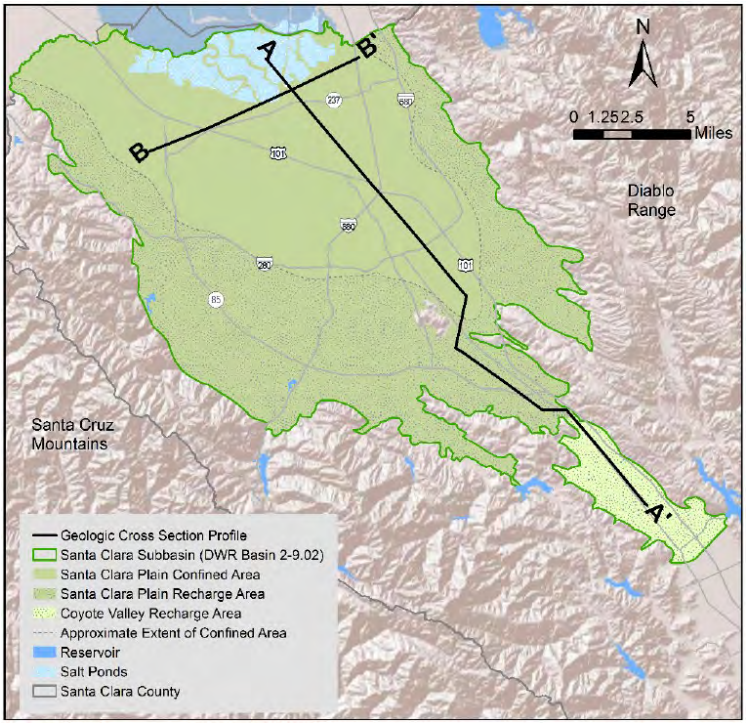


Figure 5. Santa Clara Subbasin transverse cross-section B – B' (taken from Figure 2-5 in the 2016 GWMP).

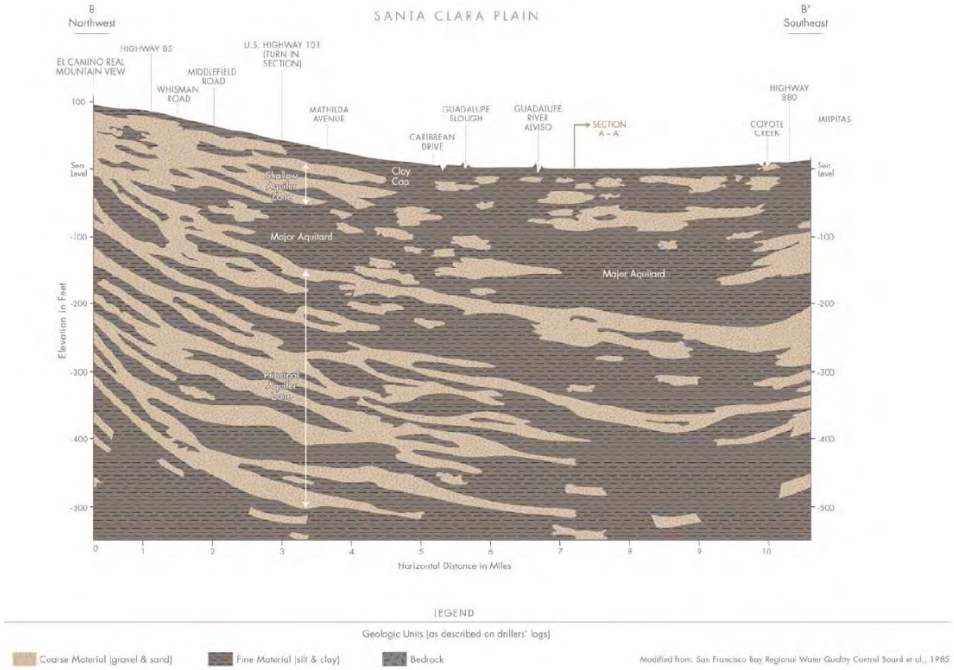
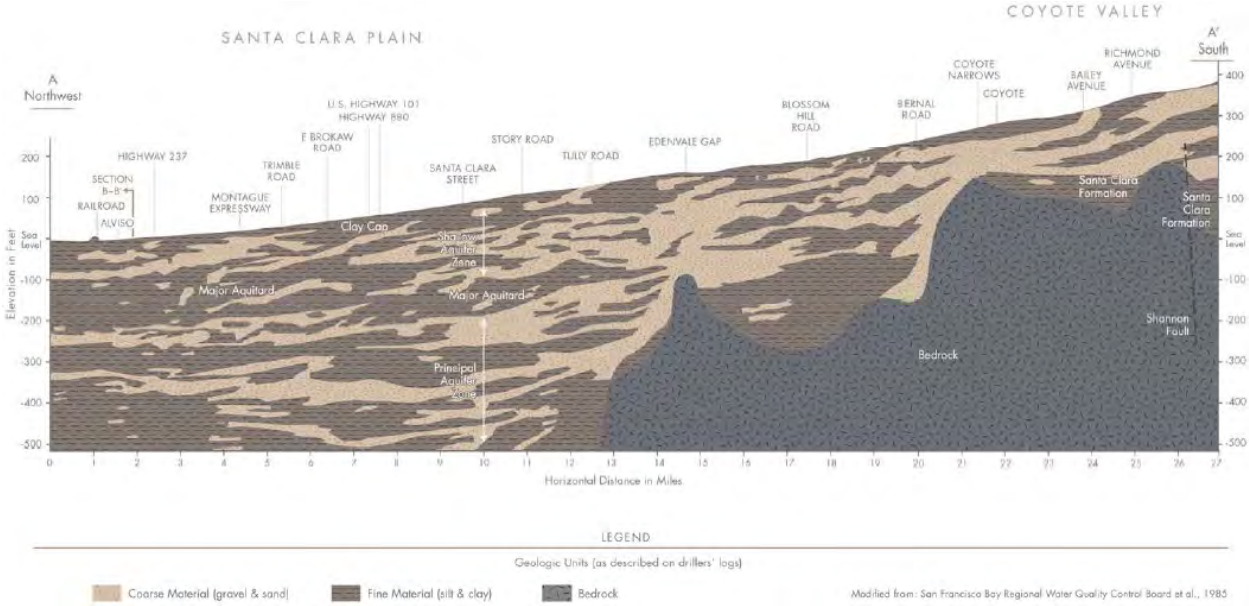


Figure 6. Santa Clara Subbasin longitudinal cross-section A – A' (taken from Figure 2-4 in the 2016 GWMP).



Downgradient of the alluvial fan, stratification of aquifer and aquitard material increases, and the unconfined aquifer is divided into separate aquifers by a regionally extensive aquitard that pinches out in the elevated recharge area and thickens in the basin interior and near the Baylands area (Figures 5 and 6). The regional aquitard is at depths of about 150 to 250 feet below land surface (bls) in the mid- to lower-fan area and 100 to 150 feet bls in the Baylands area (Figures 5 and 6) (Iwamura, 1980). The regional aquitard separates the upper, shallow aquifer zone and the deeper, principal aquifer zone (Figures 5 and 6). The strong artesian conditions of wells screened in the principal aquifer (Valley Water, 2020) indicate that the regional aquitard is highly impervious and restricts inter-aquifer flow of groundwater, including upward flow from the principal aquifer to the shallow aquifer zone and downward flow from the shallow aquifer to principal aquifer zone.

The aquifer materials were likely deposited by sand and gravel-filled braided stream channels that were carved into a prevailing clayey surface marking past Quaternary glacial epochs, and subsequently buried by a fining upward sequence of younger sedimentary deposits (Wentworth et al., 2015). As a result of this depositional environment, present day aquifers have a somewhat complex morphology and may possess more lateral continuity than previously described in Iwamura (1980) (Wentworth et al., 2015). Nonetheless, this depositional environment results in numerous aquifers in the shallow aquifer zone within the central drainage axis (beneath Guadalupe River and Coyote Creek), and conversely, relatively few aquifers in the shallow aquifer zone beneath the Cities of Santa Clara and Sunnyvale more distant from the central drainage axis (Iwamura, 1980). The Palo Alto and Mountain View Bayfront areas have two relatively thin aquifers in the shallow aquifer zone with vertically hydraulic connection between them, but no vertical hydraulic connection with the lower principal aquifer zone (Iwamura, 1980).

The hydrogeologic conceptual model of the Baylands study area includes groundwater in the upper shallow multi-layered aquifer zone, which is about 100 feet in thickness and is underlain by a regional aquitard and principal aquifer zone (Iwamura, 1980) (Figures 5 and 6). Drilling logs of the shallow system indicate numerous and somewhat thin layered aquifer units consisting of sand and gravel deposits separated by layers of silt and clay at most sites. Appendix H-2 includes detailed geologic logs and cross

sections from the Baylands that further illustrate the highly stratified nature of the somewhat thin aquifer layers and aquitards and the limited lateral continuity of the aquifer layers, both in the shallow and principal aquifer zones. The aquifer units, although shallow, often express some degree of local confinement (Figure 5 and 6). Iwamura (1980) described the degree of confinement in the shallow aquifer zone ranging from perfectly confined to leaky (semi-) confined condition. In the shallow aquifer zone, the degree of confinement generally increases because of the increasing thickness of clayey aquitards and Bay mud (Iwamura, 1980). Although existing drillers logs and geologic cross sections (Appendix H-2) help shape the general conceptual model, the lateral continuity of individual aquifer layers in the shallow aquifer zone and the degree of interconnection between those aquifer layers is largely unknown (Iwamura, 1980).

Below the regional aquitard is the principal aquifer that is used as a public water supply. The shallow multi-layered aquifer zone is generally not used as a public water supply. Recharge to the confined aquifers in the principal aquifer zones occurs from natural recharge from rainfall and other sources and Valley Water's managed recharge activities. The shallow aquifer zone has relatively small seasonal fluctuations in water levels because this zone has limited groundwater pumping. The principal aquifer zone has relatively larger seasonal fluctuations in water levels because of substantial groundwater pumping in this zone. Water level fluctuations to barometric pressure variations are relatively small in the shallow aquifer zone as compared to the principal aquifer zone because of the relatively greater degree of confinement in the deeper aquifer zone.

In addition to groundwater occurring in confined to semi-confined aquifer layers, the shallow aquifer zone can have locally, perched groundwater on impermeable clay layers or lenses in random locations (Iwamura, 1980). Additionally, within the shallow aquifer zone an unconfined water table can develop in the very top layer near land surface (Heath, 1989). In the Baylands, this top layer is almost exclusively composed of fine-grained flood basin (Bay mud) deposits. Iwamura (1980) refers to this unconfined water table in the Baylands as semiperched groundwater, which occurs within a predominantly clay (Bay mud) section and does not have an unsaturated zone between the perched groundwater and underlying aquifer layer (Iwamura, 1980). Iwamura (1980) notes that the semiperched groundwater in the Baylands can occur over a large area and often within 10 to 20 feet bls. Recharge to the semiperched groundwater is likely from surface sources that includes rainfall, streamflow, and periodic flooding of streams (Iwamura, 1980). Recharge to the semiperched groundwater may also occur from upward flow through leaky confining (aquitard) units in the shallow aquifer zone (Iwamura, 1980). The semiperched groundwater has relatively small seasonal fluctuations in water levels because this zone is not pumped for water supply. However, temporary and permanent dewatering activities throughout the Santa Clara Plain likely pump groundwater from the semiperched groundwater and deeper parts of the shallow aquifer zone.

Prior to groundwater development in the Baylands, semiperched groundwater naturally discharged and flowed back to the Bay. Due to development and subsidence, a levee system has been constructed along the bayfront, which restricts natural discharge and surface drainage from the Baylands to the Bay. Consequently, drainage ditches have been constructed in the Baylands to help drain the semiperched groundwater toward the Bay.

The conceptual model of shallow and principal aquifer zones reflects the very complex geologic and hydrogeologic conditions of the Baylands. Because of the disconnected nature of the aquifer layers, each individual aquifer could have different groundwater (potentiometric) levels (Iwamura, 1980) since the hydraulic connectivity between the aquifers is restricted by the Bay mud, interbedded aquitards, and regional aquitard.

Given the complexity of the hydrogeologic setting and lack of geologic logs, the groundwater conditions further north of the Baylands and beneath the southern portion of the San Francisco Bay are not well understood. Previous studies have identified a shallow aquifer zone, called the Newark aquifer, at depths from 60 to 140 feet below the Bay and a deeper aquifer, called the 180-foot aquifer, at depths from 180 to 200 feet below the Bay. The shallow Newark aquifer has elevated chloride concentrations from SWI, while wells drilled in the 180-foot aquifer have tapped freshwater (Iwamura, 1980). The Centerville aquifer is located beneath the Newark aquifer but is not as well defined as the Newark aquifer (Iwamura, 1980). The degree of hydraulic connection between the shallow and principal aquifer zones of the Baylands and the aquifers beneath the Bay and the Niles Cone area (Newark, 180-foot, and Centerville aquifers) is not well understood. It is suspected that these aquifer systems are not directly connected (Iwamura, 1980) given the thick and relatively impermeable deposits of Bay mud that likely limit direct hydraulic connection. The lack of hydraulic connection between the three aquifer systems beneath the Bay and the Baylands shallow and principal aquifer zones is relevant for Valley Water's conceptual model of SWI and SLR, as described below.

2.1.2. Sea-Water Intrusion Mechanisms

There are at least four likely mechanisms that contribute in varying degrees to SWI and affect the overall extent of the 100 mg/L chloride isocontour in the Santa Clara Plain shallow aquifer zone. These mechanisms include "classic" SWI, leakance of saltwater beneath tidal stream flow, bypass flow from the shallow to principal aquifer zone, and entrapped connate water. The following sections describe these four mechanisms and the relative contribution that each has on SWI and the spatial extent of the 100 mg/L chloride isocontour in the shallow aquifer zone.

2.1.2.1. Classic SWI

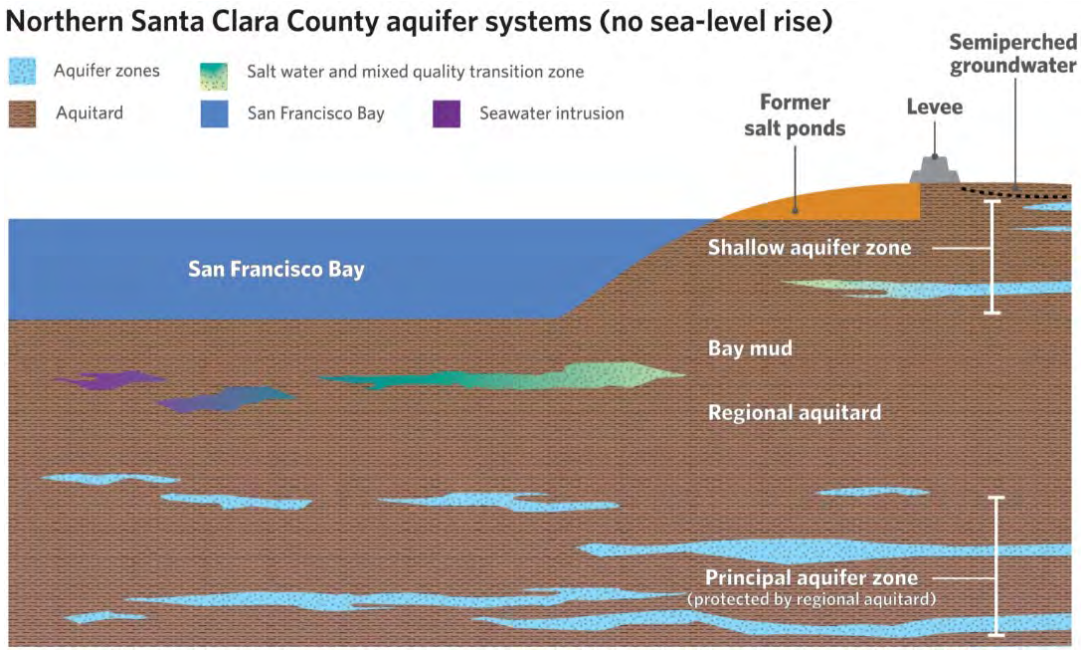
The hydrogeologic setting beneath the Baylands does not readily support the "classic" case of SWI, as illustrated in Figure 1. As explained previously, the thin, sinuous, and laterally limited aquifer layers in the Baylands that are both blanketed and interbedded by the relatively impermeable Bay mud and clay aquitards, behave much differently to groundwater pumping and tidal hydrodynamics as compared to unconfined, coastal aquifers with laterally extensive aquifer sediments with direct hydraulic connection to the ocean, as illustrated in Figure 1. The hydrogeologic setting supports the conceptual model that the predominant SWI process of the Baylands is likely quite different than the classic case of SWI. This conceptual model is supported by the following discussion of groundwater quality in the Baylands.

Within the shallow aquifer zone, Iwamura (1980) notes that the classic case of SWI has likely occurred only a short distance inland from the bayfront, estuaries, or salt evaporation ponds. This area is characterized by displacement of freshwater in some aquifer layers by seawater and has total dissolved solids (TDS) concentrations above 5,000 mg/L. The classic SWI is often induced by groundwater pumping and characterized by a relatively narrow and distinct transition or front between the saline groundwater (often called a saltwater wedge) and fresh groundwater, with the aquifers outcropping offshore in most cases (Figure 1). The transition from saline to fresh groundwater is called the zone of dispersion and is influenced by tidally driven hydrodynamic dispersion. The classic SWI is characterized by saline groundwater (saltwater wedge) flowing inland and displacing fresh groundwater (Figure 1). The saltwater wedge shape is a function of the less dense freshwater that floats on the denser saltwater. Iwamura (1980) concludes that the classic SWI in the shallow aquifer zone was caused by historic (pre-1970s) groundwater

overdraft that reversed the hydraulic gradient, which was originally (pre-development) and currently toward the Bay.

Recent groundwater quality monitoring data by Valley Water that are used to create the 100 mg/L chloride isocontours (Figure 2) indicates that the spatial extent of the classic SWI front is likely limited to some aquifer layers beneath the south San Francisco Bay and, to a lesser extent, the salt evaporation ponds (Figure 8). These locations can be inferred from the chloride concentrations from monitoring wells, as shown in Figure 2. There are five monitoring wells with chloride concentrations above 1,000 mg/L. One of those wells had 27,400 mg/L chloride concentration (Figure 2) and is likely influenced by the entrapped connate water, as described below. The other four monitoring wells have chloride concentrations that range from 1,000 to 4,000 mg/L and are located inland a relatively short distance (about one mile) from the salt evaporation ponds. Seawater typically has chloride concentrations of about 19,000 mg/L, San Francisco Bay water has 10,000 to 17,000 mg/L chloride concentrations (Iwamura, 1980), and brackish water in tidal estuaries can have chloride concentrations on the order of 500 to 5,000 mg/L (Drever, 1982; Hem, 1989; Barlow, 2003). Iwamura (1980) considers the 5,000 mg/L chloride isocontour to represent the inland extent of classic SWI. Therefore, the SWI front (zone of dispersion) is likely to have higher chloride concentrations than these four monitoring wells, thus indicating that the SWI front is likely further to the north and beneath the San Francisco Bay and/or salt evaporation ponds (Figure 7). Figure 7 also illustrates that the shallowest aquifer layers beneath the San Francisco Bay, such as the Newark aquifer, likely have SWI and elevated chloride concentrations. However, deeper aquifer layers, such as the 180-foot and Centerville aquifers may have freshwater and/or lower chloride concentrations than the San Francisco Bay. One of Valley Water's former monitoring well sites (called "L-site" and located on the northeast corner of pond A9, Don Edwards San Francisco Bay National Wildlife Refuge) had a deeper well likely screened in the 180-foot aquifer and had generally freshwater with low chloride. However, the shallow well at L-site was screened around 80 feet and appeared to have trapped connate water or water affected by resolubilized evaporite deposits because the chloride concentrations were higher than the Bay water.

Figure 7. Conceptual diagram illustrating classic seawater intrusion (SWI) limited to beneath the south San Francisco Bay and former salt evaporation ponds.



Groundwater quality within the semiperched zone is not currently monitored by Valley Water, nor has it been monitored historically except in a few locations near the edges of the saltwater marshlands, according to Iwamura (1980). However, it is possible that some shallow monitoring wells for leaking underground storage tank sites or other GeoTracker sites may be screened within the semiperched zone. Iwamura (1980) observed a difference in groundwater of the semiperched groundwater as compared to the shallow groundwater zones. The limited groundwater quality samples in the semiperched zone had a higher salt content, including chloride concentrations as high as 5,000 mg/L, which were hypothesized by Iwamura (1980) to originate from degradation of historical agricultural wastewater or evapoconcentration processes that are not necessarily attributed to SWI. The high clay content and poor drainage conditions of the semiperched sediments could have contributed to the accumulation of agricultural wastewater and increased salt concentrations in the soil and semiperched groundwater. However, it is possible that SWI in the semiperched groundwater could be occurring only in areas that are either in contact with saltwater bodies at the bayfront, the salt evaporation ponds, or at locations along stream channels where tidal incursion of saltwater occurs (Iwamura, 1980), as described below. Elevated boron concentrations have been observed in some localized areas of the semiperched groundwater (Iwamura, 1980), which could indicate the presence of SWI because of the elevated concentration of boron in seawater (on the order of 4 to 5 mg/L in seawater and 3.8 mg/L in Bay water (Iwamura, 1980)).

Based on current and historical groundwater monitoring data, Valley Water conceptualizes that classic SWI from the San Francisco Bay has a relatively minor influence on the spatial extent of SWI and the 100 mg/L chloride isocontour in the shallow aquifer zone of the Baylands (Figure 7). Additional details that support a limited influence of the classic SWI mechanism on shallow aquifers in the Baylands are presented in the conceptual model for SLR in the following sections.

2.1.2.2. Leakance of Saltwater Beneath Tidal Stream Flow

The historic groundwater overdraft prior to the 1970s also caused land subsidence in the Santa Clara Plain, which created a land surface depression that could enable ocean tides to extend farther upstream than would have occurred without subsidence (Iwamura, 1980). This land subsidence, in combination with vast estuarine mudflats preventing seawater from directly entering the principal aquifer system, has resulted in the shallow groundwater having a wide mixed quality transition zone (Figure 8) with mild intrusion of shallow aquifers (as defined by the 100 mg/L chloride isocontour) extending farther inland than the typical classic SWI front. The term mixed quality transition zone was first used by Iwamura (1980) and refers to the inland areas and much of the bayfront salt ponds within the 100 mg/L chloride isocontour, as shown in Figure 2.

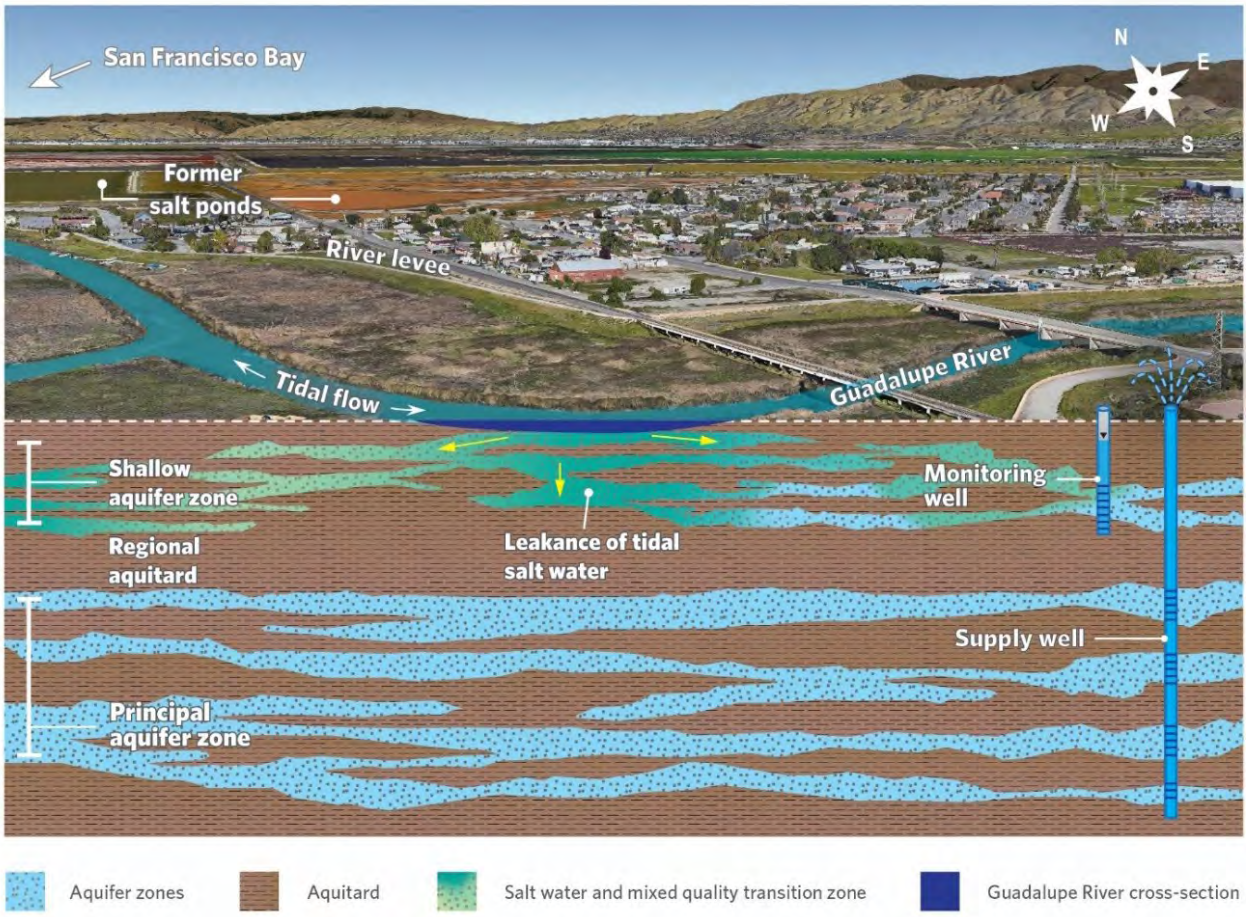
Iwamura (1980) observed that the greatest inland intrusion of the mixed quality transition zone occurred along the Guadalupe River and Coyote Creek (Figure 8). This observation indicates an apparent relation between SWI in the shallow aquifer zone and inland areas along the stream channels where the clay cap is thinnest at land surface and where the greatest abundance of shallow aquifers exists (Iwamura, 1980). Iwamura (1980) concluded that the spatial extent of the mixed quality transition zone is largely caused by the tidal saltwater flows within the streams that leak through the streambed and clay cap into the shallow aquifer zone when this zone is pumped.

Historical groundwater pumping from the shallow aquifer zone may have contributed to the lateral spreading of the SWI that leaks beneath the tidally influenced streambeds. For example, Iwamura (1980) observed seasonal patterns in chloride concentrations during the 1960s and 1970s in two wells screened

in the shallow aquifer zone near the Guadalupe River area south of Alviso. These wells had the highest seasonal chloride concentrations during the fall near the end of the groundwater pumping season and lowest seasonal chloride concentrations during the spring and wetter part of the year prior to the groundwater pumping season. Iwamura (1980) hypothesized that the groundwater pumping induced lateral SWI that was sourced from the tidal saltwater flow up the nearby Guadalupe River that had infiltrated downward through the streambed.

Based on current and historical groundwater monitoring data, Valley Water conceptualizes that the leakance of saltwater from tidal stream flow has a relatively major influence on the spatial extent of SWI and the 100 mg/L chloride isocontour in the shallow aquifer zone of the Baylands. Additional details that support the important influence of leakance of saltwater from tidal stream flow mechanism are presented in the conceptual model for SLR, specifically the following section on tidal effects on groundwater.

Figure 8. Conceptual diagram of seawater intrusion (SWI) in the Santa Clara Subbasin by the mechanism of leakance of saltwater beneath tidal streamflow. Modified from Iwamura (1980).



2.1.2.3. By-Pass Flow Down Improperly Constructed or Destroyed Wells

The clay aquitard between the shallow and principal aquifer zones is relatively thick and impermeable (Figures 5 to 9), and thus prevents downward flow of classic SWI or flow from the mixed transition zone from the shallow to the principal aquifer zone. Iwamura (1980) characterized the SWI in the principal

aquifer zone as mild and limited to a much smaller area than the shallow aquifer zone. In general, the SWI in the principal aquifer is located beneath the areas of classic SWI in the shallow aquifer zone. However, Iwamura (1980) notes a few isolated and seasonal occurrences of elevated chloride in the principal aquifer zone beneath the wider mixed transition zone. Iwamura (1980) attributed these isolated occurrences as the result of seasonal slugs of either tidal water or mixed transition zone water that were induced from the shallow aquifer zone. Given the relatively thick and impermeable clay aquitard, the limited occurrence of SWI in the principal aquifer zone is likely the result of downward by-pass flow through improperly constructed, maintained, or abandoned wells.

Iwamura (1980) noted three locations in the principal aquifer zone that have mild SWI (chloride concentrations above 300 mg/L): beneath the Guadalupe River south of Alviso where the overlying shallow aquifer zone has SWI; Palo Alto bayfront area where the overlying shallow aquifer zone has SWI; and Palo Alto area west of Highway 101 where the shallow aquifer zone does not have SWI (Iwamura, 1980, plate 8). Valley Water monitoring wells at Eleanor Pardee park in Palo Alto also show increasing TDS and chloride concentrations with increasing depth, which may be attributed to poorly flushed connate water and not necessarily related to SWI. These three locations should be evaluated as possible locations for future SWI monitoring, as described in the recommendations below. However, Iwamura (1980) also notes that more areas of the principal aquifer zone had SWI in the 1960s, which had improved over the intervening years because the 1980s analysis showed no SWI in those area. Since the 1980s, Valley Water's groundwater management activities, including recharge and former well sealing assistance programs, have continued to improve supply conditions in the principal aquifer zone, creating strong artesian conditions and a regional hydraulic gradient toward the Bay. These conditions are important for preventing the landward migration of the SWI in the principal aquifer zone.

Valley Water's annual groundwater quality monitoring results indicate that very few Baylands wells in the principal aquifer zone have elevated TDS or chloride concentrations that would be indicative of SWI (Valley Water, 2020). Additionally, with one exception, all Baylands wells in the principal aquifer zone sampled by Valley Water have either stable or decreasing chloride concentrations over the period of 2005 to 2019 (Figure 9). The one principal aquifer zone well with increasing trend in chloride concentrations is in Palo Alto near the entrapped connate water, as described below. Downward migration of saline shallow groundwater into the principal aquifer zone has been prevented due to Valley Water's managed and in-lieu recharge activities, which maintain artesian conditions (upward vertical hydraulic gradient) in the Baylands area (Valley Water, 2020).

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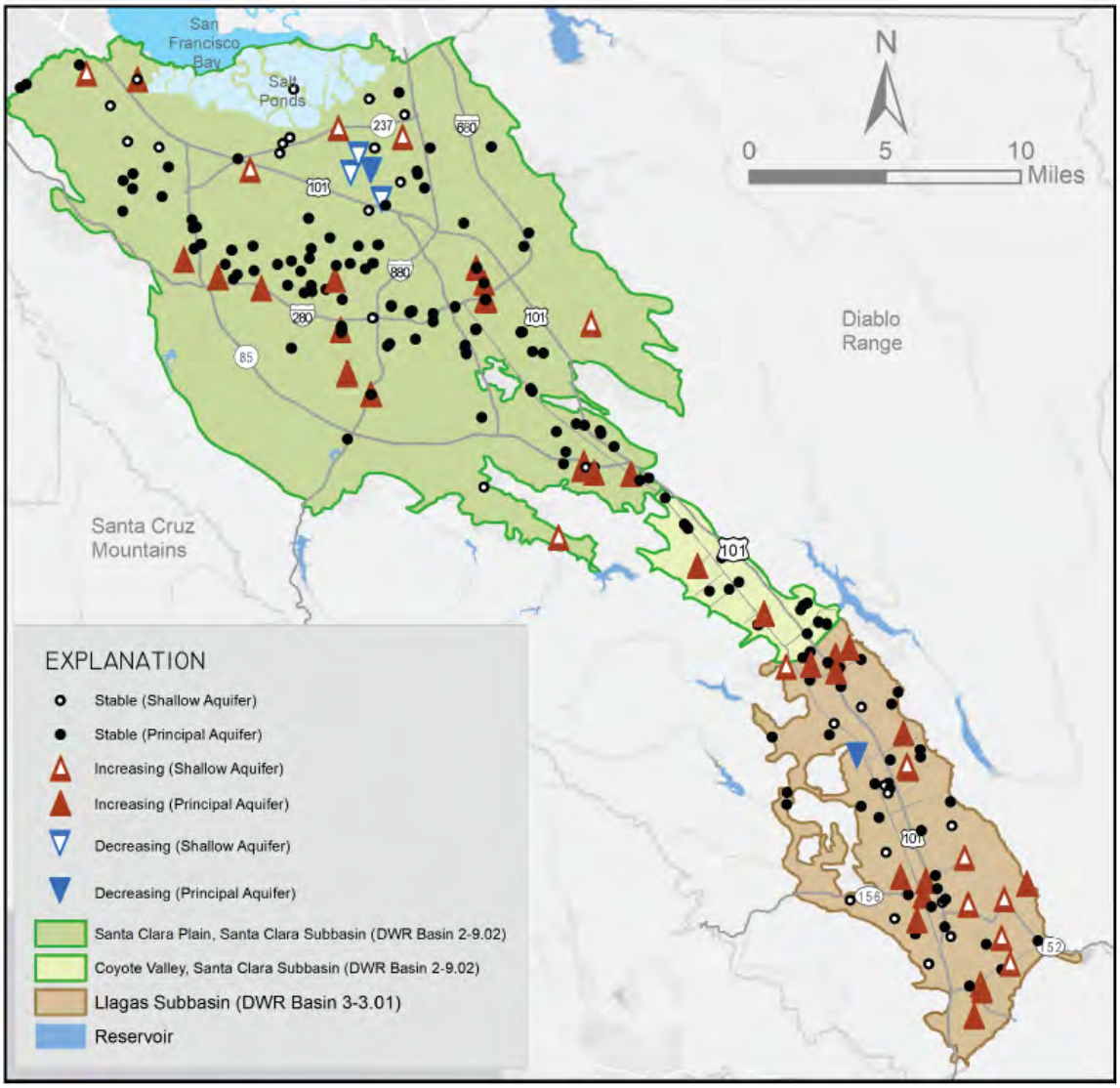
Figure 9. Chloride concentration trends in the shallow and principal aquifer zones (2005 – 2019) (taken from Figure 24 in Valley Water's 2019 Annual Groundwater Report).



While the existing groundwater quality data indicates that the principal aquifer zone is relatively protected from the various SWI mechanisms, Valley Water currently conducts only limited monitoring of the principal aquifer in the Baylands area because few deeper wells are available. Figure 9 illustrates that the monitoring wells near the Baylands have a relatively lower spatial density as compared to many other areas of the county. As described below in this memorandum, one recommendation is to increase the density of monitoring in both the principal and shallow aquifer zones to better monitoring and evaluate potential SWI.

2.1.2.4. Entrapped Connate Water

Iwamura (1980) noted localized and high salt concentrations within the shallow aquifer zone in the Palo Alto and southeast San Jose bayfront area (Figure 2). These concentrations are much higher than seawater and are indicative of brines. Therefore, Iwamura (1980) concluded that the water is likely from entrapped connate water that has undergone an evapoconcentration process in the geologic past. Connate water

refers to the water that was trapped in the pores of the sediments and sedimentary rocks as they were deposited, and connate water is not attributed to present-day SWI. The area of the brine connate water is indicated by the well with 27,400 mg/L chloride concentration in Figure 2.

Given that the connate water is not associated with present-day SWI and found only in localized areas of Palo Alto and southeast San Jose, the entrapped connate water is not an important mechanism for SWI and likely has a low influence on the spatial extent of the 100 mg/L chloride isocontour throughout the Baylands. However, the brine connate water does have a localized influence on the 100 mg/L chloride isocontour line. Given the relatively low density of monitoring wells and strong gradient in chloride concentrations near the brine connate water, another recommendation is to evaluate the benefit of installing additional monitoring wells in both the shallow and principal aquifer zones to better characterize the spatial extent and influence of the brine connate water on the 100 mg/L chloride isocontour.

2.1.2.5. Summary of SWI Mechanisms and Implications

The following section summarizes the relative role of each of the four SWI mechanisms in terms of affecting the 100 mg/L chloride isocontour across the Santa Clara Subbasin. The parts of the groundwater system(s) most at risk from each of the four SWI mechanisms is also summarized here.

"Classic" SWI: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism is largely constrained by the hydrogeologic setting of the subbasin, which include thick deposits of Bay mud that have very low hydraulic conductivity and create confined, semi-confined, and perched groundwater conditions (Figure 7). The shallow aquifer zone is the part of the system most at risk from this SWI mechanism.

Leakance of saltwater beneath tidal stream flow: this mechanism likely has a relatively major role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism is largely constrained to areas near tidal rivers and creeks but can migrate laterally in the shallow aquifer system (Figure 7). The shallow aquifer zone, especially near the Guadalupe River and Coyote Creek, is the part of the system that is most at risk from this SWI mechanism.

By-pass flow down improperly constructed or destroyed wells: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. However, if this mechanism occurs, it presents the greatest risk to groundwater quality in the principal aquifer zone.

Entrapped connate water: this mechanism likely has a relatively minor role in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism has a localized influence on groundwater quality in the shallow and principal aquifer zone near the bayfront in Palo Alto (Figure 2).

2.2. Sea-Level Rise (SLR) and Implications for Groundwater in the Santa Clara Subbasin

Climate change driven increases in global air temperature and associated thermal expansion of the oceans and melting of polar and glacial ice is projected to increase sea-level rise (SLR) worldwide (IPCC, 2021). In the San Francisco Bay, as much as one to two feet of SLR is projected by mid-21st century (2050) and two

to six feet by the end of the 21st century (2100) (City and County of San Francisco, 2020). Under the H++ extreme scenario with significant melting of the arctic ice sheets, the projected SLR in the San Francisco Bay is more than 10 feet by 2100 (California Ocean Protection Council, 2018).

Climate change has a range of implications for groundwater supply and quality (Green et al., 2011; Taylor et al., 2012). In particular, SLR is likely to increase seawater intrusion in many coastal unconfined aquifers worldwide (Figure 10) (Treidel et al., 2012). SLR and tidal forcing will also cause the groundwater table to rise in coastal areas of California, and in low-lying areas the water table could approach and ultimately rise above the ground surface (Figure 10) (Hoover et al., 2017). This SLR-driven groundwater shoaling (rising) and emergence above ground surface in coastal aquifers of California is more likely to occur in unconfined aquifers that have a direct hydraulic connection to the ocean (Figure 10) (Hoover et al., 2017). A rapid assessment method developed for shallow, unconfined coastal aquifers indicates that SLR-driven groundwater emergence is a potential effect of future climate change in many unconfined aquifers surrounding the San Francisco Bay (Plane et al., 2019). SLR-driven groundwater emergence in unconfined aquifer surrounding the San Francisco Bay is projected to be more prominent in low-lying areas with shallow water tables, and gentle topography with abundant topographic drainage features may likely limit the rise of inland water tables in response to SLR (Befus et al., 2020).

Although SLR-driven groundwater emergence and SWI is a likely concern for many unconfined aquifers in California, recent studies have not evaluated the effects of SLR on groundwater in confined or semi-confined coastal aquifers, such as the northern part of the Santa Clara Subbasin with thick deposits of Bay mud (Figures 5-9). Based on the previous discussion in this memo about the classic case of SWI having a limited spatial extent from the Bay, Valley Water conceptualizes that SLR may increase SWI and chloride concentrations in similarly limited parts of the aquifer systems beneath the Bay, and short distances inland from the bayfront, estuaries, and salt evaporation ponds (Figure 11). It is possible that SLR-driven groundwater emergence may occur in the semiperched groundwater and shallow aquifer zone on the inland side of the levee system. However, the very low hydraulic conductivity of the Bay mud is likely to mitigate some effect of groundwater shoaling and emergence in areas of the semiperched groundwater table. Studies that assume unconfined aquifer conditions and connectivity between the Bay and adjacent aquifers and neglect the very low hydraulic conductivity of the Bay mud are likely to overestimate the magnitude and extent of SLR-driven groundwater emergence of the northern Santa Clara County aquifer systems. Additional monitoring and modeling studies are needed to better understand the connection between Bay water, semiperched groundwater, and the shallow aquifer zone to more accurately project SWI and SLR-driven groundwater emergence. The following discussion about tidal influence on groundwater in the shallow aquifer zone indicates that the connection may be somewhat limited.

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Figure 10A. Typical coastal unconfined aquifer outside Santa Clara County under natural conditions with no sea-level rise.

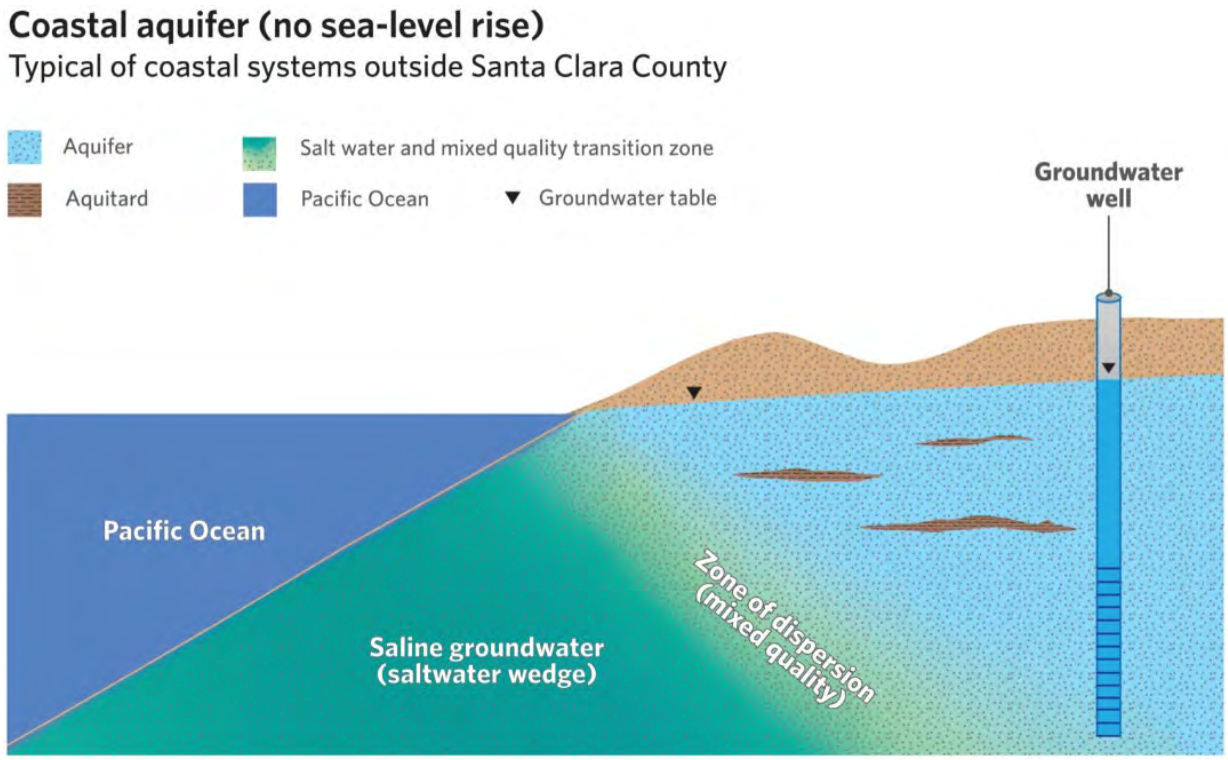


Figure 10B. Typical coastal unconfined aquifer outside Santa Clara County with sea-level (SLR) from climate change.

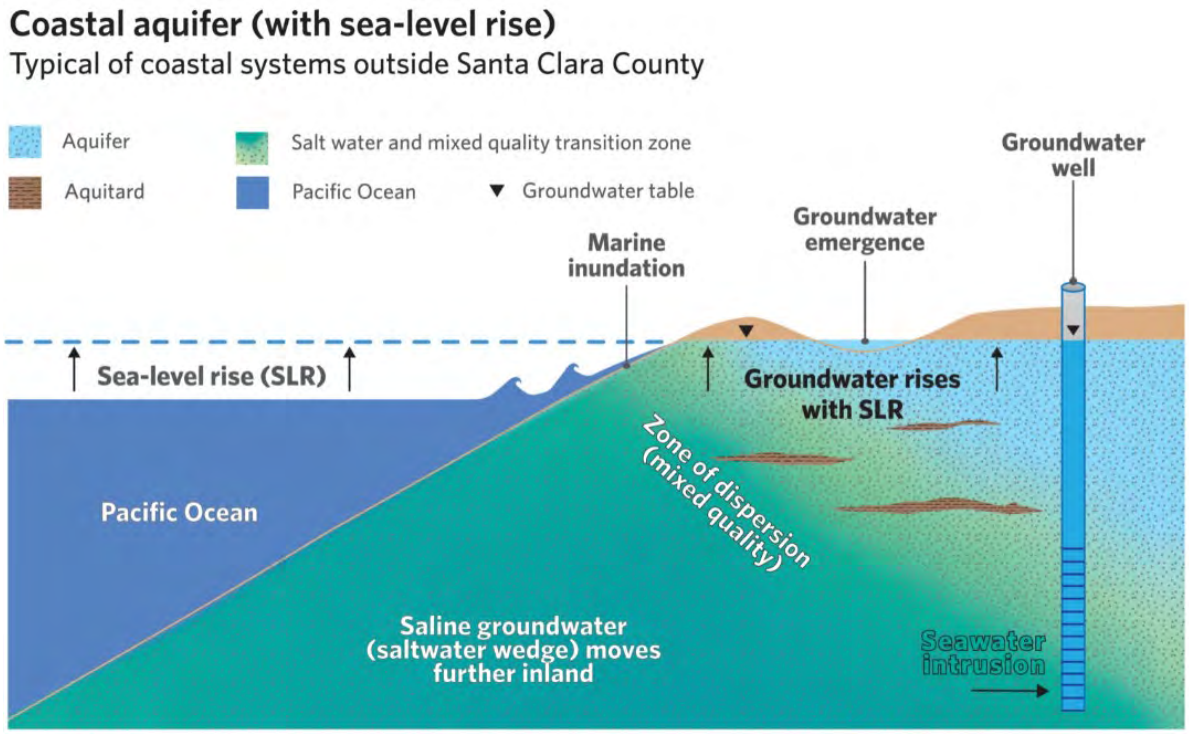
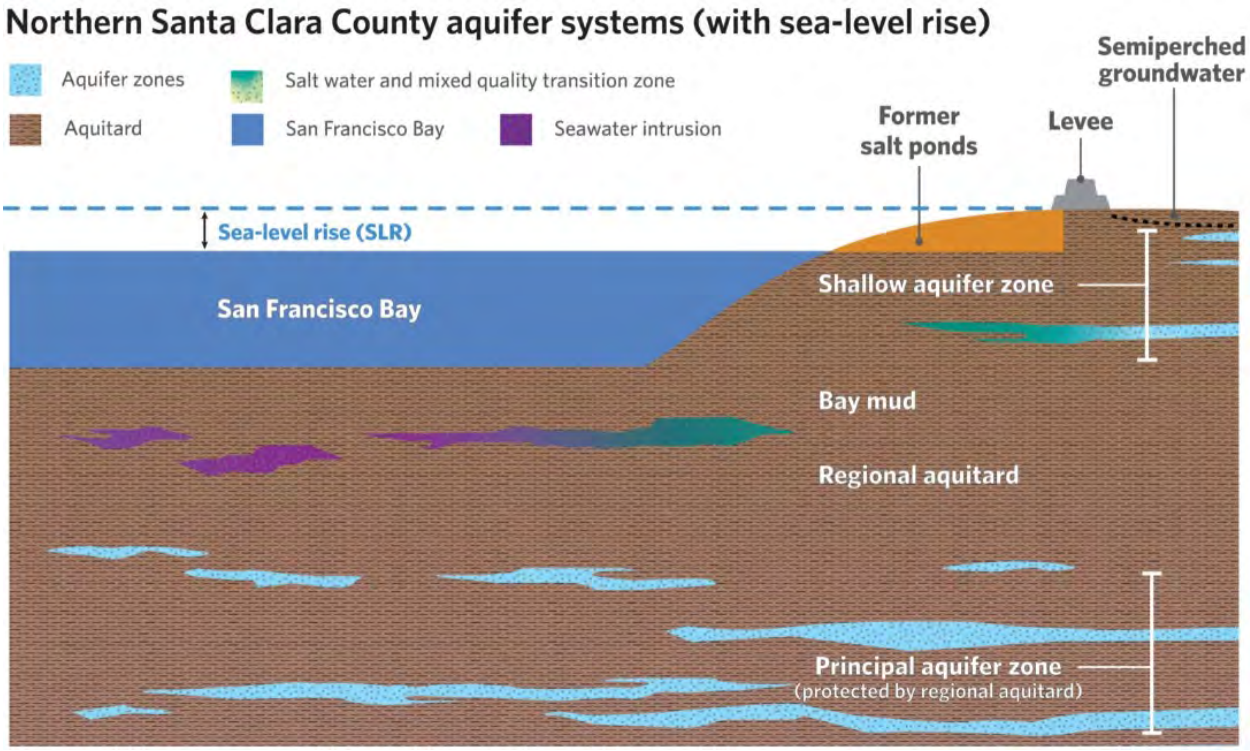


Figure 11. Conceptual diagram illustrating sea-level rise (SLR) effects on groundwater and seawater intrusion (SWI) limited to beneath the south San Francisco Bay and former salt evaporation ponds.



2.3. Tidal Effects on Groundwater in the Santa Clara Subbasin

To evaluate how projected SLR may affect groundwater and the role of the Bay mud deposits in the Santa Clara Subbasin, it is important to first understand present-day tidal effects on groundwater. A recent memo by Valley Water (Valley Water, 2020) evaluated the relationship between observed ocean tides of the southern San Francisco Bay and groundwater levels in the shallow aquifer system of the Santa Clara Subbasin. This memo provides some insight into the possible response of groundwater in the shallow aquifer system to projected SLR over the 21st century. The following sections summarize the most relevant findings.

The San Francisco Bay and inter-tidal tributaries experience a diurnal, sinusoidal tide fluctuation having a duration of approximately 6 hours between peaks and troughs. The peak-to-trough amplitude varies depending on astronomical alignments of the sun and moon. New moon periods exhibit the largest peak-to-trough amplitudes of tides because during these periods the gravity of the sun and moon have a combined effect, rather than a cancelling effect. The NOAA Alviso Slough at Gold Street Bridge tide station (Figure 3) has an average difference between peak and trough of about 6 to 7 feet. Periods of extreme tides could result in approximately 10 feet of fluctuation at this tide station (Valley Water, 2020).

Groundwater level data in the wells in the shallow aquifer zone and tidal variation in the adjacent streams show that two of 20 stations (Figure 3; Guadalupe shallow well (map ID 3) and Guadalupe deep well (map ID 4)) exhibit a water level response that appears influenced by tides (Figures 13 and 14) (Valley Water, 2020). At the other sites (18 of 20), no evidence of tidal forcing was observed in the shallow aquifer zone during the period of study in 2019 (see Valley Water, 2020, Appendix A). These results indicate that the

multi-layered shallow aquifer system in the Santa Clara Subbasin is generally not in direct hydraulic communication with waters of bay and tidal estuaries and tributaries. The very fine-grained flood plain and estuarine deposits (Bay mud) typical of the south bay have blanketed the upper aquifer zone, essentially isolating it from interaction and influence by overlying surface water bodies including the bay itself, tidal estuaries, and inter-tidal stream tributaries. The relatively low hydraulic conductivity value of Bay mud has been estimated at 1.7×10^{-4} feet/day or 6.0×10^{-8} cm/sec (U.S. Army Corp of Engineers, 1999).

Figure 12. Hydrograph of the Guadalupe deep well (06S01W10N007) with tide stage from the Alviso Slough at Gold Street Bridge tidal station (from Valley Water, 2020).

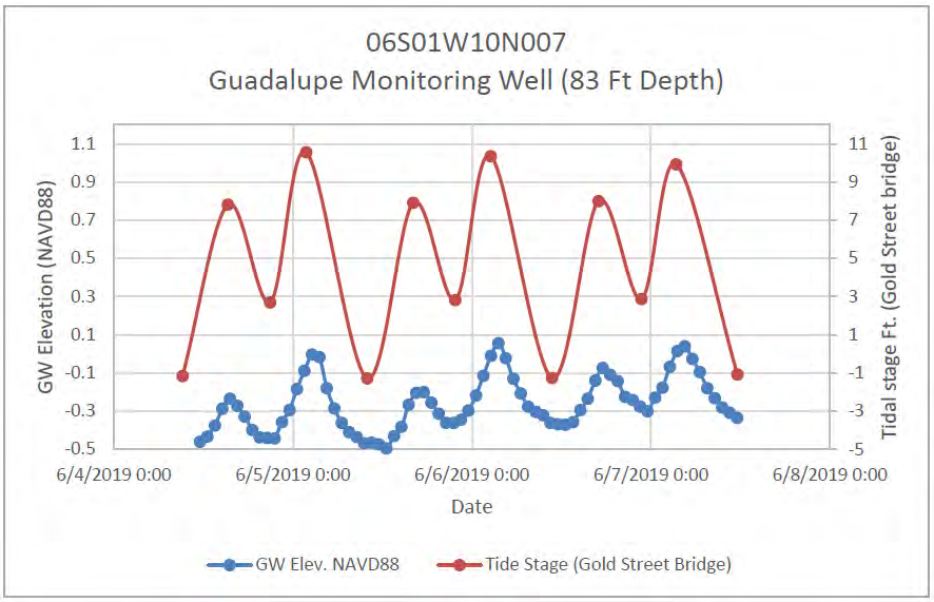
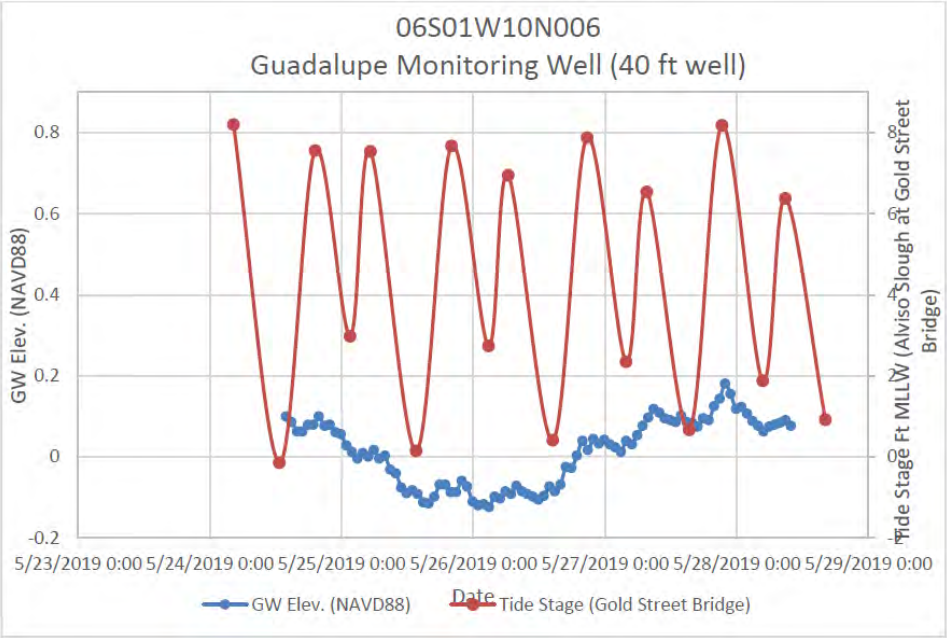


Figure 13. Hydrograph of the Guadalupe shallow well (06S01W10N006) with tide stage from the Alviso Slough at Gold Street Bridge tidal station (from Valley Water, 2020).



Figures 13 and 14 are hydrographs that show a tidal forcing signal in the two Guadalupe monitoring wells (06S01W10N007 and 0601W10N006) from a single location along Guadalupe River near the Highway 237 over-crossing. Note that the vertical axes representing groundwater elevation in Figures 13 and 14 are an order-of-magnitude smaller than the tidal stage axis. The location of the Guadalupe monitoring wells is about 0.5 mile inland from the Alviso Slough at Gold Street Bridge NOAA tidal station (Figure 3). Both wells are relatively shallow (40 and 83 feet below land surface), screened in the shallow aquifer zone, and are located directly adjacent to an inter-tidal portion of Guadalupe River (Figure 3). This site represents a shallow multi-layered aquifer system as each well is perforated (screened) in a separate aquifer that appears at least somewhat confined from above and below by fine grained flood plain and estuary type deposits.

There is an apparent correlation between tide stage and groundwater level in the Guadalupe Deep (80-foot) well (Figure 12) (Valley Water, 2020). The temporal variability in the groundwater level is in phase, dampened, and slightly lagged behind the peak tidal stage on the order of less than a few hours. Between about 6 and 9 feet of tidal induced stage change is observed at the Alviso Slough at Gold Street Bridge tidal station, while a maximum of about 0.5 feet of groundwater level fluctuation is observed in the well during the same week (Figure 12). The timing and fluctuation of stage height in the Guadalupe River channel directly adjacent to the wells is not precisely known.

Valley Water (2020) also noted that it was unexpected that the water level in the Guadalupe Shallow (37-foot) well shows less hydraulic connection than the Guadalupe Deep well to the tidal stage, but still has an apparent and highly dampened response (Figure 13). During the four days of collecting data, the water level declined approximately 0.2 feet and then recovered almost 0.3 feet in the well. Superimposed on this decline and recovery are smaller amplitude (about 0.05 feet) rise and fall of the water level that is generally in-phase with the tidal stage (Figure 13). Similar to the response in the Guadalupe Deep well, some of the peaks in the water levels are slightly lagged behind the peak tidal stage, as seen in two of the last three peaks in water levels in Figure 13.

At all other wells shown in Figure 3, no clear relationship between tides and groundwater level was observed (see Valley Water, 2020, Appendix A). This was an unexpected result, particularly for some of the very shallow wells located within the tidal limit and near what are believed to be tidal influenced stream reaches and estuaries (Figure 3) (Valley Water, 2020).

An important conclusion from the Valley Water (2020) analysis is that, in general, the shallow aquifer zone of the Santa Clara Subbasin does not seem to be in direct hydraulic connection with tidal estuaries and stream channels that drain into San Francisco Bay. Within tidal stream channels, the estuary muds are conceptualized as a low permeability 'skin' lining the channel bottom and sides, substantially limiting the hydraulic connection to underlying shallow groundwater. In addition, much of the shallow aquifer zone is composed of fine grained, low permeability silts and clays thus further limiting flow and connection to surface water.

The two known exceptions to this conceptual model are the Guadalupe Deep and Shallow wells that have an apparent response in water levels (Figures 13 and 14) and chloride concentrations to the tidal stage (Valley Water, 2020). These wells are each perforated in thin sand and gravel layers within a mostly silt and clay upper aquifer zone. Additional detailed investigation is required to understand why the response in those two wells is different than the other 18 wells analyzed. Strong upward trends in the concentration of chloride, an indicator of seawater intrusion, has also been observed at the Guadalupe Deep well site since at least 2006. This upward chloride trend began after nearby completion of bridge reconstruction

to allow flood waters to pass more freely underneath (Valley Water, 2020). This and other possible explanations should be further explored. However, the tidal response in water levels, increasing chloride concentrations, and proximity of the Guadalupe Deep and Shallow wells to the Guadalupe River generally support the conceptual model that the leakance of saltwater beneath tidal streamflow is an important mechanism that has a relatively major influence on the spatial extent of SWI and the 100 mg/L chloride isocontour in the shallow aquifer zone of the Baylands.

Given these findings at the Guadalupe Deep and Shallow monitoring wells, these two wells should be included with subsequent monitoring network for the new SWI OM, as described below. Several other wells had statistically significant increasing and decreasing trends in chloride concentration but based on locations outside the tidal limit were inconclusive in identifying a correlation with tidal fluctuations (Valley Water, 2020). These wells should be further monitored for temporal trends in chloride as a potential early warning indicator of SWI. Valley Water (2020) provide recommendations for additional monitoring to better understand the tidal influence on groundwater conditions, particularly over longer time periods and hydrologic variability.

The conceptual model outlined in Valley Water (2020) acknowledges that present day tidal fluctuations only offer a short-term "rise" in sea level to evaluate the response in groundwater heads. Future SLR, on the other hand, will result in a permanent increase in sea level elevation, in addition to tidal fluctuations. Re-establishment of the equilibrium between groundwater in the shallow aquifer and the Bay will likely occur slowly in response to permanent sea level rise and may manifest differently as compared to present-day high or extreme King tides. A more definitive assessment of the future response of the groundwater system to SRL is not possible without the aid of a numerical, statistical, or geographic information system (GIS)-based model that accurately considers the very low hydraulic conductivity of the Bay mud and semi-confined and confined conditions of the shallow and principal aquifer zones of the Santa Clara Subbasin. However, the OM and OM-LT outlined in this memo will help provide Valley Water early-warning monitoring for SWI and SLR-driven changes in groundwater associated with future climate change.

2.3.1.1. Summary of SLR Implications on SWI Mechanisms

The following section summarizes the relative implication of SLR on each of the four SWI mechanisms in terms of affecting the 100 mg/L chloride isocontour across the Santa Clara Subbasin. The hydrogeologic and groundwater system(s) most at risk from these SLR-driven effects on the four SWI mechanisms is also summarized here.

"Classic" SWI: SLR is likely to have a relatively minor effect on the role of SWI mechanism in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This influence of SLR on classic SWI is largely constrained by the hydrogeologic setting of the subbasin, which include thick deposits of Bay mud that have very low hydraulic conductivity and create confined, semi-confined, and perched groundwater conditions (Figure 11). The shallow aquifer zone is the part of the system most at risk from SLR-driven classic SWI.

Leakance of saltwater beneath tidal stream flow: SLR is likely to have a relatively major effect on the role of SWI mechanism in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. SLR is likely to increase the extent of tidal incursion in rivers and creek, which could expand the area of the 100 mg/L chloride isocontour. The shallow aquifer zone, especially near the Guadalupe River and Coyote Creek, is the part of the system most at risk from SLR-driven leakance of saltwater beneath tidal stream flow.

By-pass flow down improperly constructed or destroyed wells: SLR is likely to have a relatively minor effect on the role of this SWI mechanism in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. The impact of this mechanism will be minimized by maintaining a strong managed recharge program that supports continued artesian conditions in the confined, principal aquifer zone. However, if SLR creates a downward hydraulic gradient in the shallow aquifer zone, this mechanism of by-pass flow presents the greatest risk to groundwater quality in the principal aquifer zone.

Entrapped connate water: SLR is likely to have a relatively minor effect on the role of this SWI mechanism in the overall spatial extent of the 100 mg/L chloride isocontour across the Santa Clara Subbasin. This mechanism has a localized influence on groundwater quality in the shallow and principal aquifer zone near the bayfront in Palo Alto (Figure 2).

Marine inundation: this was not discussed as one of the current mechanisms that influence present-day SWI. However, SLR is likely to increase the probably of temporary marine inundation, especially during high tide and King tide events. Although the shoreline levee project is considering SLR, temporary or permanent marine inundation could happen in the future along some parts of the shoreline that are adjacent to the Santa Clara Subbasin. If marine inundation occurs in the future, it will likely have the greatest impact on SWI in the perched groundwater and shallow aquifer zone immediately near the bayfront of the Santa Clara Subbasin.

3. Approach to Develop a Seawater Intrusion Outcome Measure

The new seawater intrusion (SWI) outcome measure was developed following the conceptual models outlined in the previous sections. The SWI outcome measure is also largely based on chloride data that has been collected over many decades by Valley Water groundwater monitoring programs. Specifically, the SWI outcome measure is based on the chloride isocontour, which is consistent with SGMA and DWR guidance. DWR (2017) states that… "The minimum threshold metric for seawater intrusion shall be the location of a chloride isocontour. Contrary to the general rule for setting minimum thresholds, seawater intrusion minimum threshold is not set at individual monitoring sites. Rather, the minimum threshold is set along an isocontour line in a basin or management area." This approach is also consistent with Valley Water's long-standing reporting of chloride impacts in the shallow aquifer zone. The location of supply wells was also considered in developing the SWI outcome measure.

4. Results and Discussion

The following sections present and discuss the results of historical chloride isocontours in the shallow aquifer zone and location of supply wells of the Santa Clara Subbasin. The resulting SWI outcome measure (OM) and associated outcome measure-lower threshold (OM-LT) are presented here.

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4.1. Historical 100 mg/L Chloride Isocontours

Valley Water has been monitoring groundwater quality in the Santa Clara Subbasin for decades. Chloride data from wells screened in the shallow aquifer zone of the Santa Clara Subbasin was presented as the 100 mg/L chloride isocontour in the 2016 GWMP and annually in Valley Water's Annual Groundwater Report. Figure 14 is a compilation of available 100 mg/L isocontours that have been presented in recent Valley Water reports, spanning the years from 1945 to 2019.

Figure 14. Compilation of historical 100 mg/L chloride isocontours in the shallow aquifer zone of the Santa Clara Subbasin.

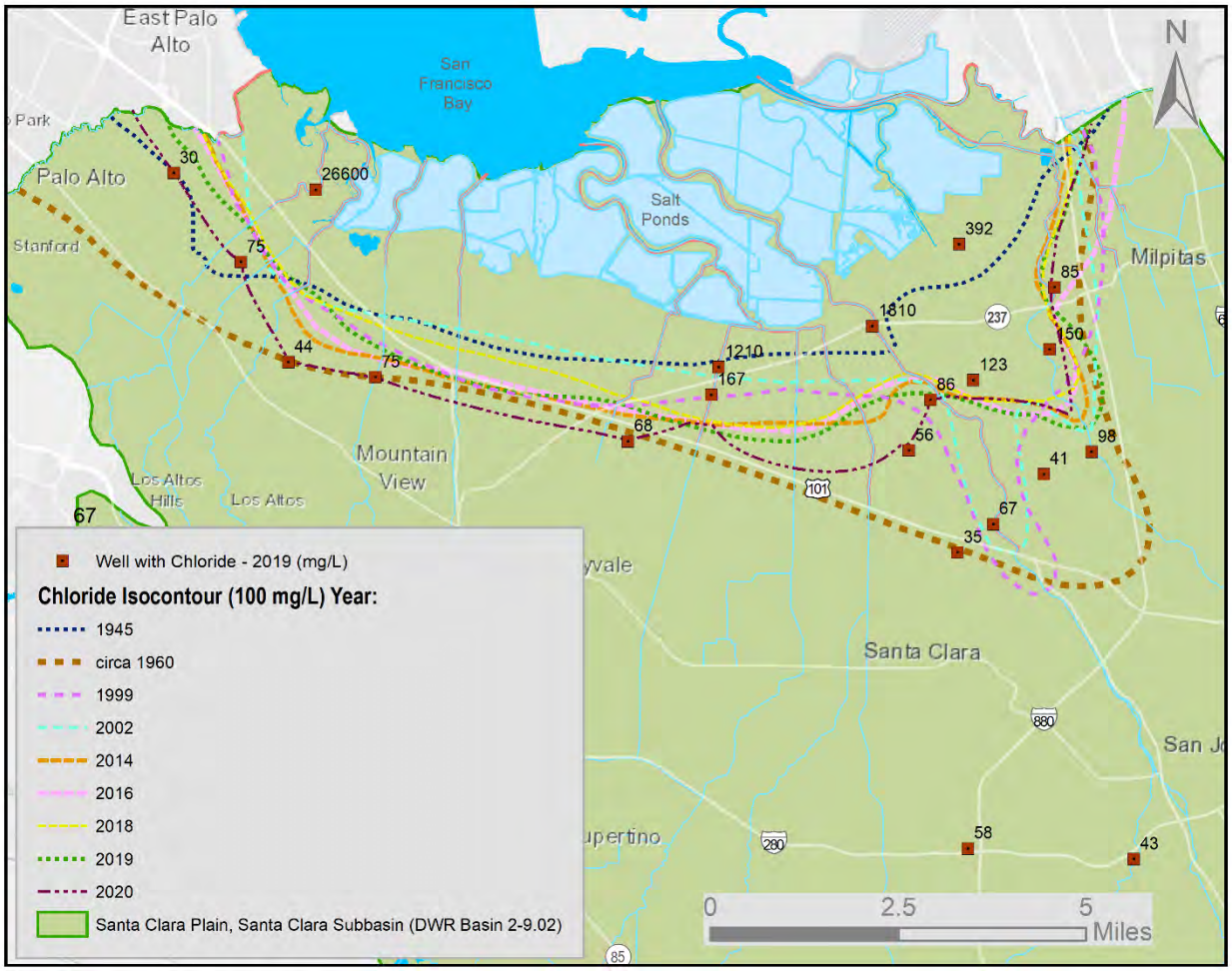


Figure 14 indicates that prior to widespread groundwater development, the 1945 extent of the 100 mg/L chloride isocontour was close to the salt ponds. But after extensive groundwater development over the next couple of decades, groundwater levels throughout the Santa Clara Subbasin had fallen substantially. As a result, Figure 14 indicates that the maximum known extent of SWI (denoted by the 100 mg/L chloride isocontour) occurred around 1960, which coincided with groundwater overdraft conditions and historic low groundwater levels throughout much of the Santa Clara Subbasin. It is important to note that the furthest inland lobe of the maximum known extent of the 100 mg/L chloride isocontour occurred near the Guadalupe River and Coyote Creek (Figure 14), which further supports the previously discussed

conceptual model that the leakance of saltwater from tidal stream flow has a relatively major influence on the spatial extent of SWI and the 100 mg/L chloride isocontour in the shallow aquifer zone. During the early and middle parts of the 20th century, prior to the urban development throughout the Santa Clara Plain that accelerated in the 1960s and 1970s, there was much more groundwater pumping from the shallow aquifer zone for agricultural use than today. This groundwater pumping from the shallow aquifer zone is likely responsible for the large increase in the spatial extent of the 100 mg/L chloride isocontour between 1945 and 1960 (Iwamura, 1980) (Figure 14).

Since the 1960s, Valley Water's groundwater management activities have helped recover groundwater levels and storage to sustainable conditions. For example, by the 1970s, subsidence in the Santa Clara Subbasin was essentially halted because of these groundwater management activities. Also, the land use conversion from agricultural to urban throughout the middle to late 20th century also corresponded with a decrease in agricultural groundwater pumping from the shallow aquifer zone. During this period, municipal supply wells were drilled and screened in the deeper, principal aquifer zone of the Santa Clara Subbasin. Valley Water also expanded the managed recharge program over this time. The result was higher groundwater levels in both the shallow and principal aquifer zones and increased hydraulic gradient toward the Bay in the shallow aquifer zone and increased upward gradient from the principal aquifer zone. In the shallow aquifer zone, these changes in hydraulic gradient resulted in a Bay-ward migration of the 100 mg/L chloride isocontours. During the period from 1999 to 2019, the 100 mg/L chloride isocontours were located much closer to the Bay than during the early 1960s (Figure 14). Again, it is important to note that the furthest inland lobe during this recent period, especially in 1999 and 2002, occurred near the Guadalupe River and Coyote Creek (Figure 14), which further supports that leakance of saltwater from tidal stream flow has a relatively major influence on the spatial extent of SWI and the 100 mg/L chloride isocontour in the shallow aquifer zone.

The area (square miles) of each 100 mg/L chloride isocontour is summarized in Table 1. To calculate the area, the subbasin boundary is used as the northern most boundary of each 100 mg/L chloride isocontour. The maximum extent of the 100 mg/L chloride isocontour circa 1960 was 57 mi^2 (Table 1). In 2019, the 100 mg/L chloride isocontour covered 40 mi^2, which is about 70% of the maximum extent (Table 1).

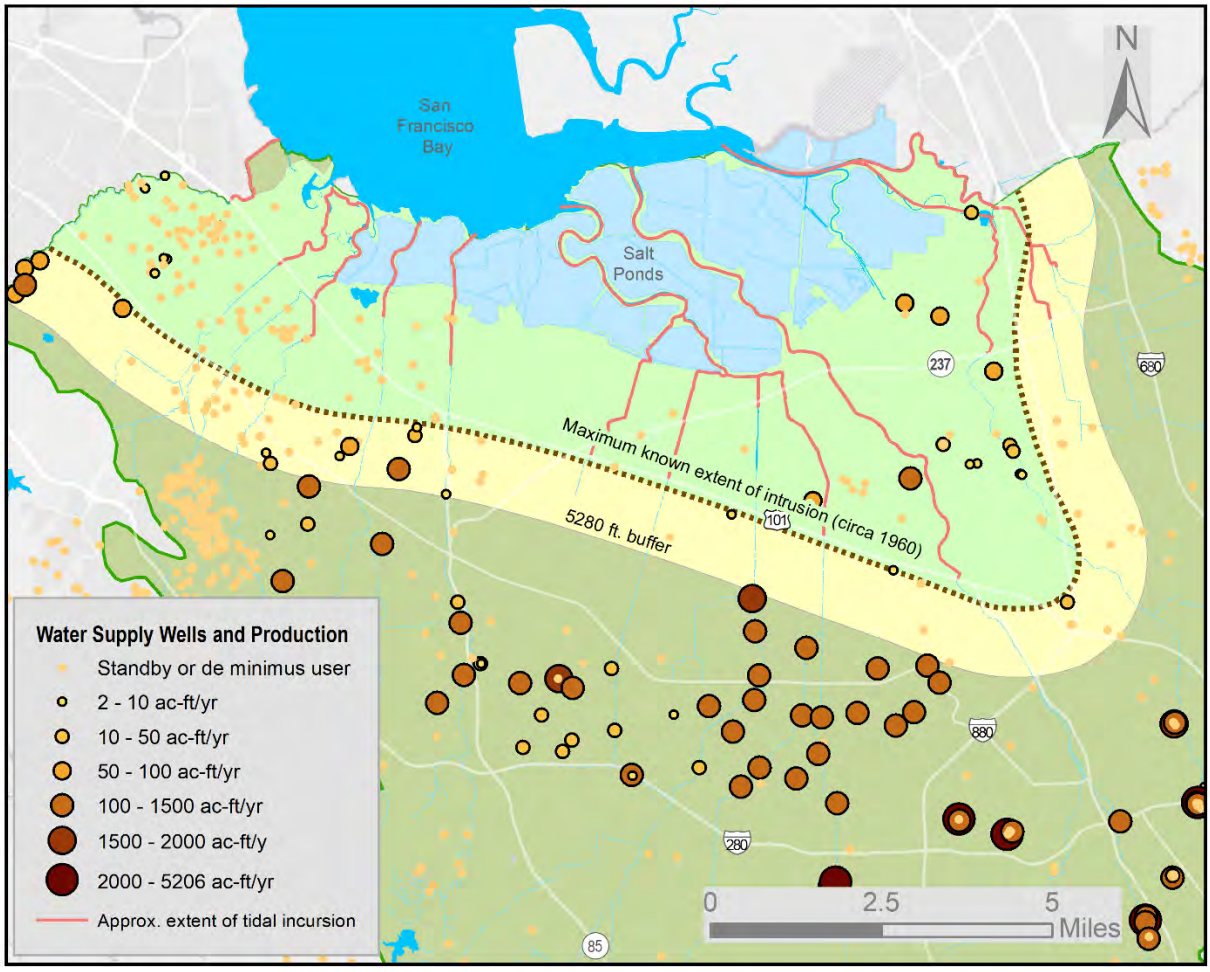
Table 1. Area (square miles) of the 100 mg/L chloride isocontours shown in Figures 15 and 16.

Year of Isocontour	Area (mi^2)	% of historical maximum extent (circa 1960)
1960s (maximum extent)	57	100%
1945	31	54%
1999	41	72%
2002	37	65%
2014	39	68%
2016	40	70%
2018	36	63%
2019	40	70%
5,280 feet radial buffer of the 1960s maximum extent	81	142%

4.2. Evaluation of Supply Well Locations

The number and location of supply wells (Figure 15) were evaluated in relation to the 100 mg/L isocontours to identify an appropriate outcome measure and outcome measure-lower threshold. Most supply wells shown in Figure 15 are screened in the deeper, principal aquifer zone. The 100 mg/L chloride isocontours are based on monitoring wells screened in the shallow aquifer zone and thus represent potential vulnerability of contamination of the deeper, principal aquifer, possibly by the previously discussed SWI mechanism of bypass flow down improperly constructed or destroyed wells. Minimizing the extent of the 100 mg/L chloride isocontour reduces the risk of downward migration of SWI from the shallow aquifer zone to the deeper, principal aquifer zone where supply wells are screened.

Figure 15. Water supply wells and production within the maximum known extent of the 100 mg/L chloride isocontour and associated 5,280-foot buffer.



Within the historical maximum extent, there are 24 active wells (Figure 15) that produced 860 AF, which is equivalent to about 1% of the total groundwater pumping in the Santa Clara Subbasin in 2013. Several radial buffers beyond the historical maximum extent were evaluated based on the number of supply wells and annual groundwater pumping. These radial buffers included 2,500 feet, 5,280 feet, and 6,000 feet. The 5,280 feet (1 mile) buffer was selected as a reasonable lower threshold to the historical maximum extent because that buffer includes only an additional 25 active supply wells that pump an additional 698 AF (based on 2013). The area within the 5,280-foot buffer is 81 mi^2, which is about 142% of the maximum

extent area in the 1960s (Table 1). The 5,280-foot buffer was also selected because it excludes a relatively high producing City of Santa Clara well (06S01W32H001) that produces about 1,700 AF (based on 2013). The maximum known extent and the 5,280-foot radial buffer have a combined total of 49 active wells that pump 1,558 AF, which is equivalent to only about 1.7% of the total groundwater pumping in the Santa Clara Subbasin in 2013. Using the 5,280-foot buffer as a lower threshold to the outcome measure will help minimize the risk of SWI vulnerability to supply wells in the Santa Clara Subbasin.

Figure 15 shows that the approximate extent of tidal incursion in creeks and rivers (Valley Water, 2020). Except for a small area on the eastern side of the Santa Clara Subbasin near the city of Sunnyvale, the extent of the tidal incursion is entirely within the maximum known extent of the 100 mg/L chloride isocontour. However, the tidal incursion near Sunnyvale is entirely within the 5,280-foot radial buffer.

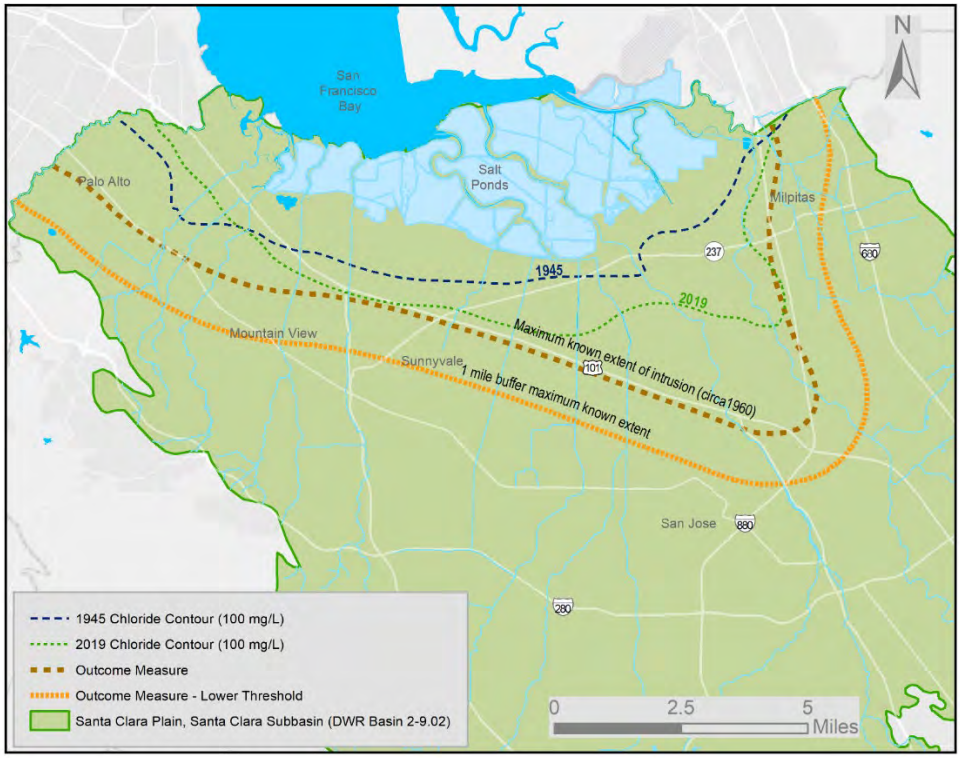
4.3. New Seawater Intrusion (SWI) Outcome Measure (OM)

Based on the analysis presented in Figures 15-16 and Table 1, the new SWI outcome measure (OM) is based on the area of the historical maximum extent of SWI (100 mg/L chloride isocontour) in the 1960s. The new SWI OM is:

> In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter (mg/L) chloride isocontour area is less than the historical maximum extent area (57 square miles).

The SWI OM is illustrated in Figure 16, along with the 100 mg/L isocontours for 1945 and 2019 as reference. As described in the 2021 GWMP, the SWI OM is functionally equivalent to a measurable objective under SGMA.

Figure 16. Spatial extent of the seawater intrusion outcome measure and outcome measure-lower threshold.



4.4. New Seawater Intrusion (SWI) Outcome Measure-Lower Threshold (OM-LT)

Based on the new SWI OM and the analysis presented in Figures 15-16 and Table 1, the new SWI outcome measure-lower threshold (OM-LT) is based on the 1 mile (5,280 feet) radial buffer of the historical maximum extent of SWI (100 mg/L chloride isocontour) in the 1960s. The new SWI OM-LT is:

> In the Santa Clara Subbasin shallow aquifer, the 100 milligram per liter chloride isocontour area is less than 81 square miles, which represents a one-mile radial buffer of the historical maximum extent area.

The SWI OM-LT is illustrated in Figure 16, along with the 100 mg/L isocontours for the OM, 1945, and 2019 as reference. As described in the 2021 GWMP, the SWI OM-LT is functionally equivalent to a minimum threshold under SGMA.

5. Conclusions and Recommendations

To prevent undesirable results stemming from SWI, it is imperative to avoid returning to the historical (pre-1970s) groundwater overdraft and pumping conditions that causes the subsidence and reversal of the natural hydraulic gradient in groundwater toward the Bay. Such conditions would likely resume the classic SWI migration inland and potentially expand the spatial extent of the 100 mg/L chloride isocontour in the shallow aquifer zone by leakance of saltwater beneath tidal stream flow, thus increasing the vulnerability of SWI into the principal aquifer zone. Similarly, groundwater pumping from the principal aquifer zone that substantially lowers the potentiometric levels and artesian conditions could enhance SWI in the principal aquifer zone by either classic SWI or downward migration from by-pass flow of improperly sealed wells. Therefore, Valley Water's continued managed and in-lieu recharge programs are critically important to maintain healthy artesian conditions (upward hydraulic gradient) in the principal aquifer zone of the Baylands area, as well as contribute to the Bayward hydraulic gradients in the shallow aquifer zone. Valley Water's managed and in-lieu recharge programs directly prevent SWI and will help ensure annual success in the meeting the SWI OM and OM-LT. Additionally, to continue preventing SWI from the by-pass flow mechanism down improperly sealed and constructed wells, it is important that all new and abandoned wells strictly follow Valley Water's well construction permitting and abandonment ordinances, respectively.

Based on our current conceptual model and new SWI OM and OM-LT, we make the following recommendations regarding future monitoring and management of SWI:

(1) Develop a standard operating procedure (SOP) that clearly describes the methods used to create the annual 100 mg/L chloride isocontour in the shallow aquifer zone. The SOP should standardize the use of the natural neighbor interpolation methods in ArcGIS, which is the method used recently by Valley Water staff to create the 100 mg/L chloride isocontour. The SOP should also create a list of monitoring wells that are consistently used (to the greatest extent possible) to create the 100 mg/L chloride isocontour. These monitoring wells should also continue to be evaluated as part of the regular gap analysis of the groundwater monitoring programs.

(2) Continue the groundwater quality monitoring in the shallow aquifer zone that is needed to create the 100 mg/L chloride isocontours but expand the groundwater monitoring to better understand the four SWI mechanisms outline in the conceptual model. Expanding the groundwater quality monitoring could include using several existing wells and/or installing new shallow monitoring

wells in the semiperched groundwater and shallow aquifer zone along the bayfront, as well as increase the density of groundwater quality monitoring in the principal aquifer zone. In particular, nested monitoring sites are recommended with wells screened in both the shallow and principal aquifer zones to monitor water levels and characterize vertical hydraulic gradients and SWI quality indicators, including chloride.

6. Acknowledgement

This memo was completed with support from many Valley Water units and staff. In particular, we thank Groundwater Management Unit staff George Cook, Victoria Garcia, Jeannine Larabee, Scott Elkins, Chanie Abuye, and Yaping Liu their valuable discussion and input regarding seawater intrusion, 100 mg/L chloride isocontour mapping, and associated groundwater quality monitoring in the Santa Clara Subbasin. We also thank the nearly two dozen Valley Water staff from the Water Utilities and Watershed divisions that participated in the internal stakeholder meetings and review process of the new outcome measures for the 2021 GWMP.

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Appendix H-1 – Valley Water, 2020, Evaluation of ocean tides on the shallow aquifer system adjacent to the southern portions of San Francisco Bay, Santa Clara Valley Water District (Valley Water), Groundwater Management Unit, Technical Memo, August 2020, 20 pgs.

Appendix H-2 – Geologic logs and cross sections of the Baylands (taken from Todd Groundwater, 2018).

TECHNICAL MEMORANDUM

Evaluation of ocean tides on the shallow aquifer system adjacent to the southern portions of San Francisco Bay

Prepared by:

Randy Behrens, P.G.

Water Resources Specialist

Jason Gurdak, Ph.D., P.H.

Senior Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.

Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

August 2020

Abstract

The effects of present-day ocean tides on coastal aquifers can provide insight into how groundwater may respond to future sea level rise that is associated with climate change. To help address this question in the shallow aquifer system of the Santa Clara Subbasin adjacent to the south San Francisco Bay, a 2019 study was conducted to evaluate how water levels in 20 representative wells respond to tidal fluctuations. Additionally, chloride concentration trends over a 15-year period were evaluated in these wells. Results indicate that only two of the 20 wells have apparent signals in the water levels that can be attributed to tidal stage fluctuations; one of the wells with a tidal signal also has a statistically significant increasing trend in chloride concentrations. These results are relatively unexpected given that five other shallow wells located within the tidal limit, screened in the shallow water table aquifer, and located immediately adjacent to streams that are tidally influenced did not show a tidal signal. The apparent lack of tidal signal in the groundwater levels can be attributed to the relatively fined-grained flood plain and estuarine deposits (bay mud) that limit direct hydraulic connection from the bay, tidal estuaries, and inter-tidal stream tributaries. The one exception where tidal signals were present (shallow and deep Guadalupe monitoring wells) may be attributed to bridge construction activities that may have pierced the bay mud and have created a more direct hydraulic connection between the bay water and shallow groundwater systems. Although findings from this analysis indicate relatively limited and direct hydraulic connection between the bay and shallow groundwater, additional studies and recommendations are provided to further evaluate how future sea level rise may affect shallow groundwater in the Santa Clara Subbasin.

Introduction

It has long been known that extreme high tides, known colloquially as *'King Tides'*, offer a unique glimpse into a future Bay Area affected by sea level rise. During these high tide events, numerous low-lying areas become temporarily flooded and impassable, which is just one of the more visible effects. What is not readily apparent is whether extreme high tides induce groundwater head fluctuations in the shallow aquifer system near the bay edge and adjacent to tidally influenced streams and estuaries. Ocean tides are known to affect water levels in some coastal aquifers (Kim, et al 2008), yet in the southern portions of San Francisco Bay, little is known. Other researchers have evaluated the transient response of groundwater emergence and shoaling at some low-lying coastal sites in California (Hoover et al., 2017), but not in the very low relief estuary type environment and multi-layered aquifer system of the southern portion of San Francisco Bay.

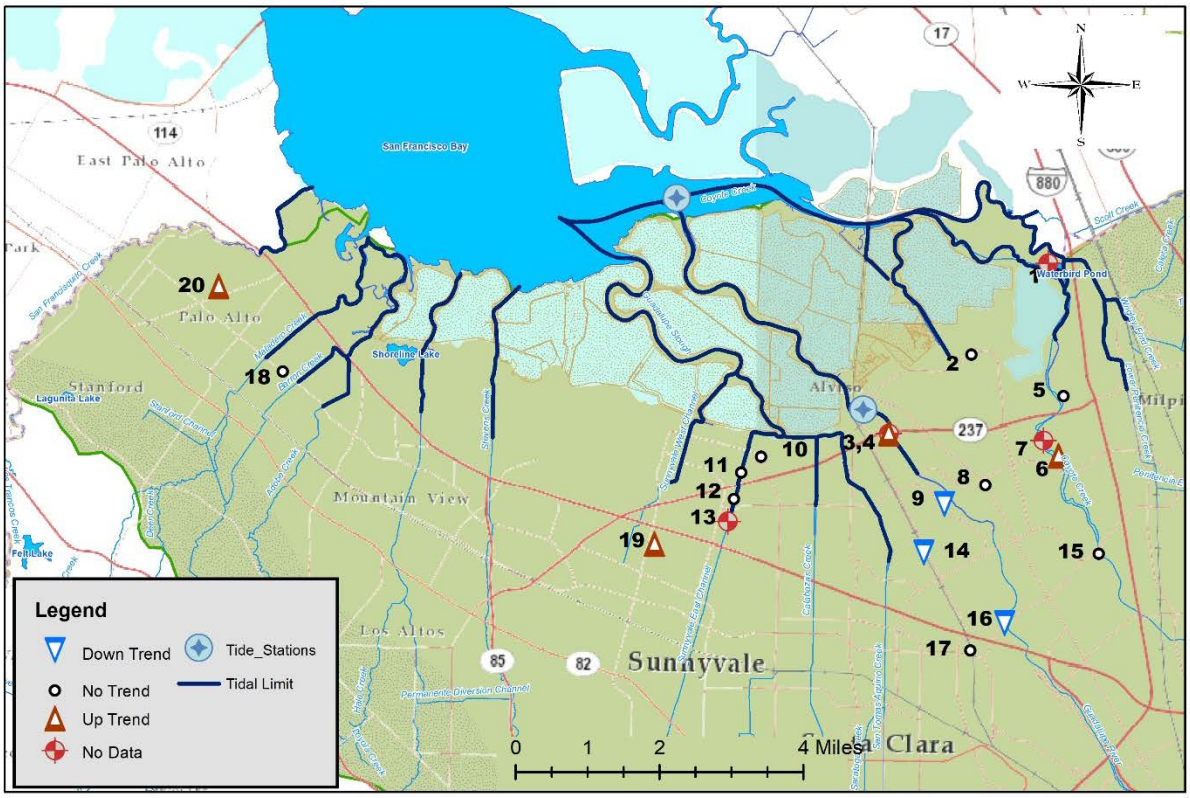
This study is motivated by recent concern about the shallow aquifer near the bay, particularly to whether projected sea level rise will result in a concurrent rise in the shallow groundwater table. In this region of the bay, shallow groundwater fluctuates in response to natural processes such as rainfall recharge, evapotranspiration, and stream stage, but generally not due to anthropogenic factors such as pumping of the shallow groundwater. The purpose of this study is to determine the relationship, if any, between ocean tides of the southern San Francisco Bay and groundwater levels in the shallow aquifer system of the Santa Clara Subbasin. It is expected that results from this analysis will provide some

insight into the possible response of groundwater in the shallow aquifer system to projected sea level rise over the 21st century.

Study Area

The study area (Figure 1) encompasses the broad alluvial plain surrounding the southern extent of San Francisco Bay shoreline contained within Santa Clara County from Palo Alto in the west to Milpitas in the east. It is generally bounded to the south by highways 101 and 880. This area is referred to as the Santa Clara County Baylands and is part of the larger Santa Clara Subbasin. The study area is the subject of an ongoing saltwater intrusion monitoring and evaluation by Valley Water and, with a few exceptions, the wells selected for this study were limited to those used to monitor for saltwater intrusion.

Figure 1. Study area, well location map, and chloride trend results (indicated by blue and red triangle symbols)



Geologic units present in study area consist of estuarine muds and marsh deposits (bay mud), alluvial fan, channel, flood basin, and levee deposits. These units consist of geologically young, unconsolidated material that form the very low relief terrain of the study area (Helley and Lajoie, 1979). Several small ephemeral and perennial streams flow through the study area and drain directly into the southern portion of San Francisco Bay. The most prominent of these streams are Coyote Creek and the Guadalupe River. During flood events, these streams carry sediment from the adjoining highlands to the lowlands where it is deposited to form flat alluvial plains and estuarine mudflats. Average rainfall is about 13

inches per year and is markedly seasonal, with almost all rain falling between October and April each year.

The focus of this study is groundwater in the shallow multi-layered aquifer zone, which is about 100 feet in thickness and underlain by a regional aquitard and principal aquifer (Iwamura, 1980). Drilling logs of the shallow system indicate numerous individual and somewhat thin layered aquifer units consisting of sand and gravel deposits separated by layers of silt and clay at most sites. The aquifer units, although shallow, often express some degree of local confinement. In addition to groundwater occurring in the semi-confined aquifer units, the shallow zone often develops an unconfined water table aquifer in the very top layer (Heath, 1989). In the study area, this top layer is almost exclusively composed of fine-grained flood basin deposits. The degree of interconnection between aquifer units, and the lateral continuity of the aquifers is largely unknown (Iwamura, 1980). Below the regional aquitard is the principal aquifer that is used as a public water supply. The shallow multi-layered aquifer zone is generally not used as a public water supply.

Land subsidence in the valley prior to the 1970s has created a land surface depression that could enable ocean tides to extend farther upstream than would have occurred without subsidence. This, in combination with vast estuarine mudflats preventing seawater from directly entering the principal aquifer system, has resulted in the shallow groundwater having a wide mixed transition zone with mild intrusion extending farther inland than typical of other coastal areas. “Classic” seawater intrusion, on the other hand, is often induced by groundwater pumping and characterized by a narrow and distinct transition from fresh to saltwater, with the aquifers outcropping offshore in most cases. This classic seawater intrusion is not occurring in either the principal aquifer of the Santa Clara Subbasin or the shallow aquifer system along the San Francisco Bay.

Methods

Water Levels and Tidal Stage

Twenty shallow wells with suspected connections to nearby tidally influenced streams and estuaries were used in this study (Figure 1, Table 1). These wells were selected because they are located within and near the upstream tidal limit, which is described below. Programable pressure transducers were used to collect water level data each hour for a period of between 72 to 96 hours from March to May 2019. Water level changes in these 20 wells were compared to data from the closest tidal station (Alviso Slough at Gold Street Bridge or Coyote Creek Tributary 1) (Figure 1) from the National Oceanic and Atmospheric Administration (NOAA).

Table 1. Well Information and Results of Tidal Stage and Chloride Trend Analysis

Map ID	*Well ID*	*Name*	*Ground Surface Elevation (NAVD88)*	*Depth (ft bgs[1])*	*Perf Top (ft bgs)*	*Perf Bottom (ft bgs)*	*Tide Signature*	*Chloride Trend*	*p-value[2]*
1	05S01W36L002	Dixon Landing	7.00[3]	20	5	20	None	--	--
2	06S01W02N008	Los Esteros	9.75	35	10	15	None	No Trend	0.368
3	06S01W10N006	Guadalupe Shallow	15.00	37	27	32	Mild	--	--
4	06S01W10N007	Guadalupe Deep	12.60	83	73	78	Strong	Increasing	<0.005
5	06S01W12G005	SCVWD C-3	16.75	37	30	35	None	No Trend	0.592
6	06S01W13C009	SCVWD C-2	36.29	66	51	60	None	Increasing	<0.005
7	06S01W13D011	MW-2	30.00	35	25	35	None	--	--
8	06S01W14L005	Tasman	17.75	47	37	42	None	No Trend	0.190
9	06S01W15R006	Lick Mill #1	15.75	57	45	51	None	Decreasing	0.042
10	06S01W17F001	Baylands Shallow	7.00[3]	110	90	100	None	No Trend	0.056
11	06S01W17M009	SE-10	12.75	45	20	45	None	No Trend	1.184
12	06S01W18R007	SE-14	12.75	45	20	45	None	No Trend	0.484
13	06S01W19A002	SE-17	10.00	45	20	45	None	--	--
14	06S01W22K010	Agnews	25.75	100	60	65	None	Decreasing	0.002
15	06S01W24J037	C-1	46.13	53	40	46	None	No Trend	0.688
16	06S01W26K001	Trimble	35.81	65	55	60	None	Decreasing	0.020
17	06S01W26N006	Comstock	42.75	100	77	82	None	No Trend	0.250
18	06S02W07B023	Toyon	14.49	45	28	45	None	No Trend	0.058
19	06S02W24J009	San Aleso	42.75	47	30	47	None	Increasing	<0.005
20	06S03W01B010	PA Library	20.25	101	93	98	None	Increasing	<0.005

1) Feet below ground surface.
2) P-values less than 0.05 indicate statistically significant trends.
3) Estimated value from Lidar.

Upstream Tidal Incursion

The tidal limit (or tidal head) is the farthest point upstream where tidal fluctuations occur in a stream channel. The tidal limit forms the upper extent of the estuary. Northern Santa Clara County has experienced historical land subsidence prior to the 1970s. Thus, it is expected that the tidal head is presently farther upstream than before subsidence was halted in the 1970s, creating a greater spatial extent for potential contamination of the shallow aquifer zone from salt water within the tidal limit.

To gain a better understanding of the extent of the tidal limit, high-resolution Lidar elevation data was examined. Using an online converter tool provided by NOAA, the tidal station datum was converted to NAVD88 datum to facilitate direct comparison to the groundwater level data. The average maximum elevation of high tide was determined to be about 10 feet NAVD88. The theoretical tidal limit was determined by locating the 10-foot elevation contour where it crosses the major creeks and tidal estuaries draining the valley floor. Figure 1 shows the theoretical tidal limit based on the high-resolution Lidar elevation data. Well information is presented on Table 1.

Results and Discussion

Water Levels and Tidal Stage

Water levels in aquifers are a significant parameter of interest in groundwater studies. Short term, daily variation in groundwater level could reflect the amount inflow and outflow from the aquifer in response to interaction with surface-water bodies (Singaraja et al., 2018). The Bay and its inter-tidal tributaries experience a diurnal, sinusoidal tide fluctuation having a duration of approximately 6 hours between peaks and troughs. The peak-to-trough amplitude varies depending on astronomical alignments of the sun and moon. New moon periods exhibit the largest peak-to-trough amplitudes of tides because during these periods the gravity of the sun and moon have a combined effect, rather than a cancelling effect. The NOAA Alviso Slough at Gold Street Bridge tide station (Figure 1) has an average difference between peak and trough of about 6 to 7 feet. Periods of extreme tides could result in approximately 10 feet of fluctuation at this tide station.

Comparison of groundwater level data in the wells in the shallow aquifer system and tidal variation in the adjacent streams show that two of 20 stations (the Guadalupe wells) exhibit a water level response that appears influenced by tides (Figures 2 and 3). At the other sites (18 of 20), no evidence of tidal forcing was observed in the shallow aquifer zone during the period examined (Appendix A). These results indicate that the multi-layered shallow aquifer system in the study area is generally not in direct hydraulic communication with waters of bay and tidal estuaries and tributaries. The very fine grained flood plain and estuarine deposits (bay mud) typical of the south bay have blanketed the upper aquifer zone, essentially isolating it from interaction and influence by overlying surface water bodies including the bay itself, tidal estuaries, and inter-tidal stream tributaries. The relatively low hydraulic conductivity value of bay mud has been estimated at $1.7E10^{-4}$ feet/day or $6.0E10^{-8}$ cm/sec (U.S. Army Corp of Engineers, 1999).

Figures 2 and 3 are hydrographs that show a tidal forcing signal in the two Guadalupe monitoring wells (06S01W10N007 and 0601W10N006) from a single location along Guadalupe River near the Highway 237 over-crossing. Note that the vertical axes representing groundwater elevation in Figures 2 and 3 are an order-of-magnitude smaller than the tidal stage axis. The location of the Guadalupe monitoring wells is about 0.5 mile inland from the Alivso Slough at Gold Street Bridge NOAA tidal station (Figure 1). Both wells are relatively shallow (37 and 83 feet below land surface) and are located directly adjacent to an inter-tidal portion of Guadalupe River (Figure 1). This site represents a shallow multi-layered aquifer system as each well is perforated (screened) in a separate aquifer that appears at least somewhat confined from above and below by fine grained flood plain and estuary type deposits.

Figure 2. Hydrograph of the Guadalupe Deep well (06S01W10N007) with tide stage from the Alviso Slough at Gold Street Bridge tidal station

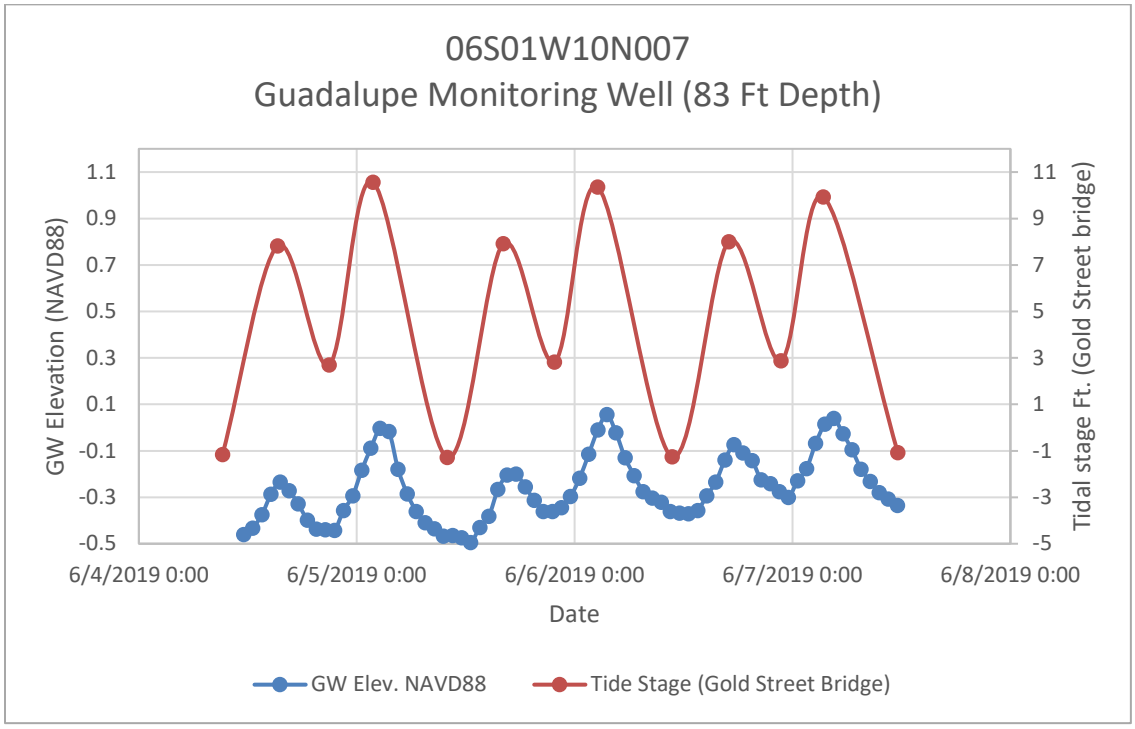
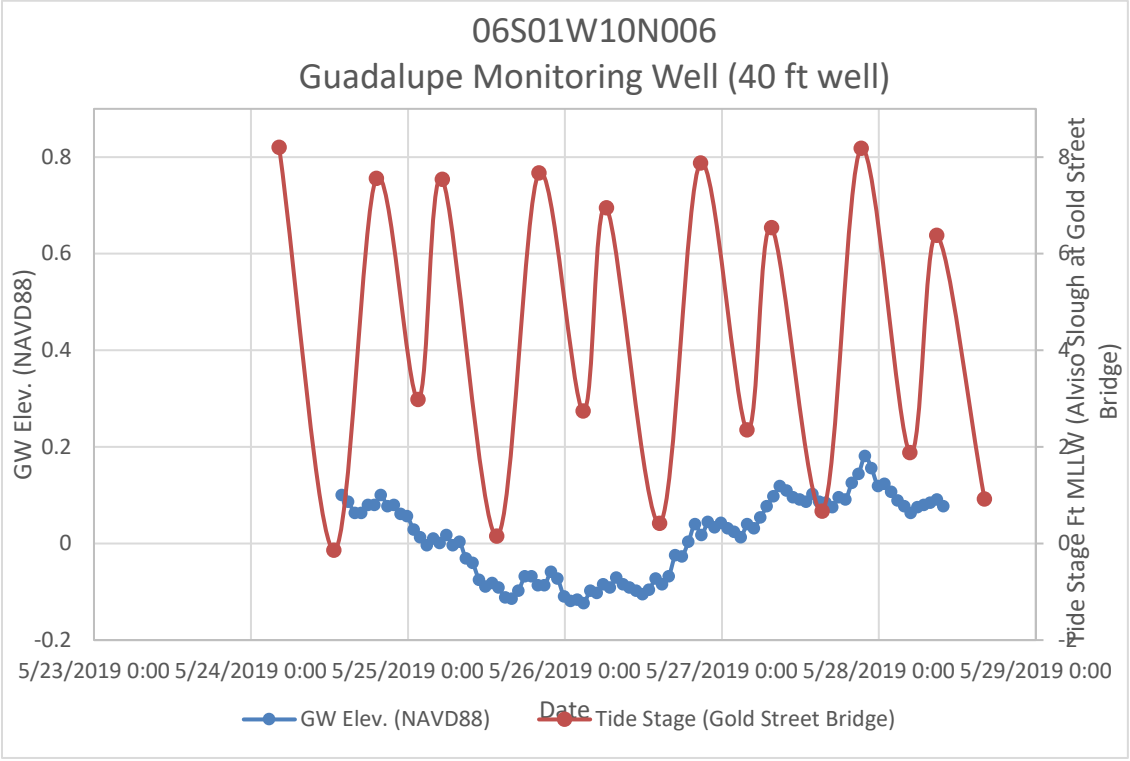


Figure 3. Hydrograph of the Guadalupe Shallow well (06S01W10N006) with tide stage from the Alviso Slough at Gold Street Bridge tidal station



There is an apparent correlation between tide stage and groundwater level in the Guadalupe Deep (80-foot) well (Figure 2). The temporal variability in the groundwater level is in phase, dampened, and slightly lagged behind the peak tidal stage on the order of less than a few hours. These time lags between the peak tide stage and groundwater levels are similar to other observed lag times of 2 and 7 hours at a coastal site in Washington State (Opatz and Dinicola, 2018). Between about 6 and 9 feet of tidal induced stage change is observed at the Alviso Slough at Gold Street Bridge tidal station, while a maximum of about 0.5 feet of groundwater level fluctuation is observed in the well during the same week (Figure 2). The timing and fluctuation of stage height in the Guadalupe River channel directly adjacent to the wells is not precisely known. This stage data directly adjacent to the wells could be gathered quite easily in future phases of work to help confirm the tidal influence from the river channel on the groundwater levels.

Surprisingly, the water level in the Guadalupe Shallow (37-foot) well shows less hydraulic connection than the Guadalupe Deep well to the tidal stage, but still has an apparent and highly dampened response (Figure 3). During the four days of collecting data, the water level declined approximately 0.2 feet and then recovered almost 0.3 feet in the well. Superimposed on this decline and recovery are smaller amplitude (about 0.05 feet) rise and fall of the water level that is generally in-phase with the tidal stage (Figure 3). Similar to the response in the Guadalupe Deep well, some of the peaks in the water levels are slightly lagged behind the peak tidal stage, as seen in two of the last three peaks in water levels in Figure 3.

At all other stations, no clear relationship between tides and groundwater level was observed (Appendix A). This was an unexpected result, particularly for some of the very shallow wells located within the tidal limit and near what are believed to be tidal influenced stream reaches and estuaries (Figure 1). As an example, the Dixon Landing Road well near Coyote Creek and the SE-10 and SE-14 wells near the Sunnyvale East Channel are within the tidal limit (Figure 1), but do not exhibit water levels with apparent responses to the tidal stage. The hydrographs for these and other wells without an apparent tidal stage response are presented in Appendix A. Numerous other wells have no apparent response to the tidal stage, but they are located some distance inland, outside the tidal limit, and some distance from creeks and estuaries, and tap semi-confined aquifer units.

The conclusion that can be drawn from these limited analyses of hydrographs is that, in general, the shallow aquifer zone does not seem to be in direct hydraulic connection with tidal estuaries and stream channels that drain into San Francisco Bay. Within tidal stream channels, estuary muds may act as a low permeability 'skin' lining the channel bottom and sides substantially limiting the hydraulic connection to underlying shallow groundwater. In addition, much of the shallow aquifer zone is composed of fine grained, low permeability silts and clays thus further limiting flow and connection to surface water. The two exceptions are the Guadalupe Deep and Shallow wells that have an apparent response in water levels to the tidal stage. They are each perforated in thin sand and gravel layers within a mostly silt and clay upper aquifer zone. Additional investigation is required to understand why the response in those two wells is different than the other 18 wells analyzed here. Strong upward trends in the concentration of chloride, an indicator of seawater intrusion, has also been observed at the Guadalupe well site since at least 2006 (Table 1). Chloride concentrations trend results are discussed below.

Present day tidal fluctuations offer a short-term "rise" in sea level to evaluate the response in groundwater heads. Future sea level rise, on the other hand, will result in a permanent increase in sea level elevation, in addition to tidal fluctuations. Re-establishment of the equilibrium between groundwater in the shallow aquifer and the bay will likely occur slowly in response to permanent sea level rise and may manifest differently as compared to present-day high or extreme King tides. A more definitive assessment of the future response of the groundwater system to sea level rise is not possible without the aid of a numerical, statistical, or geographic information system (GIS)-based model. Such a quantitative model need not be an exact representation; a simplified conceptual model domain with similar characteristics and dimensions of the real problem should provide some valuable insight. This quantitative modeling approach may entail the development of a two-dimensional cross-section model(s) orientated parallel to the regional flow direction at a few transect locations or could be developed with a statistical or GIS-based approach (Hoover et al., 2017).

Chloride Trends of Shallow Groundwater

As part of this study, it was hypothesized that temporal trends in chloride concentration may correlate with wells that have an apparent response to the tidal stage, which might indicate a direct physical hydraulic connection between the tidal incursion and shallow groundwater response. To explore this relationship, a robust non-parametric test for trend known as the non-seasonal Kendall's Trend test was used. The outcomes of these tests based on data collected over the last 15-year period are presented in Table 1. If no trend results are listed for a station, then insufficient data was available for testing.

The usefulness of trends in chloride concentrations as a predictor of tidal influence was difficult to ascertain. In one case, the Guadalupe Deep well has an increasing trend in chloride concentrations and an observed response to tidal stage (Table 1). At two other wells (San Aleso and SCVWD C-2) increasing trends in chloride concentrations are noted yet showed no evidence of response to tidal stage (Table 1). However, the San Aleso and SCVWD C-2 wells are beyond the theoretical tidal head limit (Figure 1). Temporal changes in chloride concentration could be attributed to other processes that are not necessarily a result of fluctuations in tidal stage.

The Guadalupe Deep well site has a significant and increasing trend in chloride concentration (Table 1). It is suspected that this upward trend began after nearby completion of bridge re-construction to allow flood waters to pass more freely underneath. This and other possible explanations should be further explored as either a separate phase of this work or as a special project.

Recommendations

The following recommendations are based on the results of the analysis presented here.

1) Acquire stage data of Guadalupe River directly adjacent to the Guadalupe Deep and Shallow monitoring wells (Figure 1) while collecting simultaneous groundwater levels to better understand timing of groundwater response and tidal stage at this specific location.
2) Accurately determine the tidal head by placing sensors at various points within streams and rivers draining the valley floor inside the tidal limit, preferable at times of extreme or King Tides

while collecting simultaneous groundwater levels to better understand if the freshwater shallow aquifers adjacent to and underlying tidal portions of streams within the tidal limit may be subject to infiltration of salty bay water as the tide ebbs and flows.

3) Further explore possible causes of rapid and steep upward trend of chloride concentration at the Guadalupe monitoring well site. Valley Water should be vigilant that any construction projects located near creeks within the tidal limit do not disturb the natural protection present in the form of a clay barrier or "clay cap". Such projects might include flood control work, diversion structures, bridge construction and abutments, and other deep excavations.
4) Consider development of a numerical, statistical, or GIS-based groundwater model of the upper aquifer and bay system to better examine and understand long-term effects of sea level rise on the shallow groundwater table.

Acknowledgements

Roger Pierno, Associate Engineer; Lydia Yiu, Assistant Engineer; Ardy Ghoreishi, Senior Engineering Technician; Melissa Fajardo, GWMU Intern; Colton Short, GWMU Intern.

References

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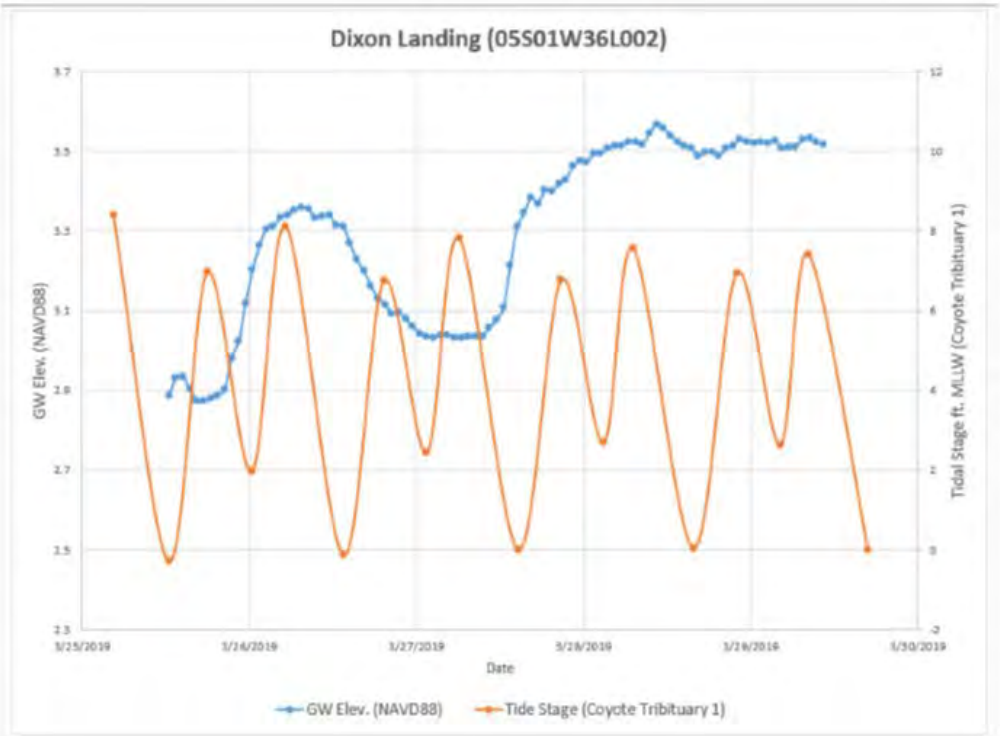
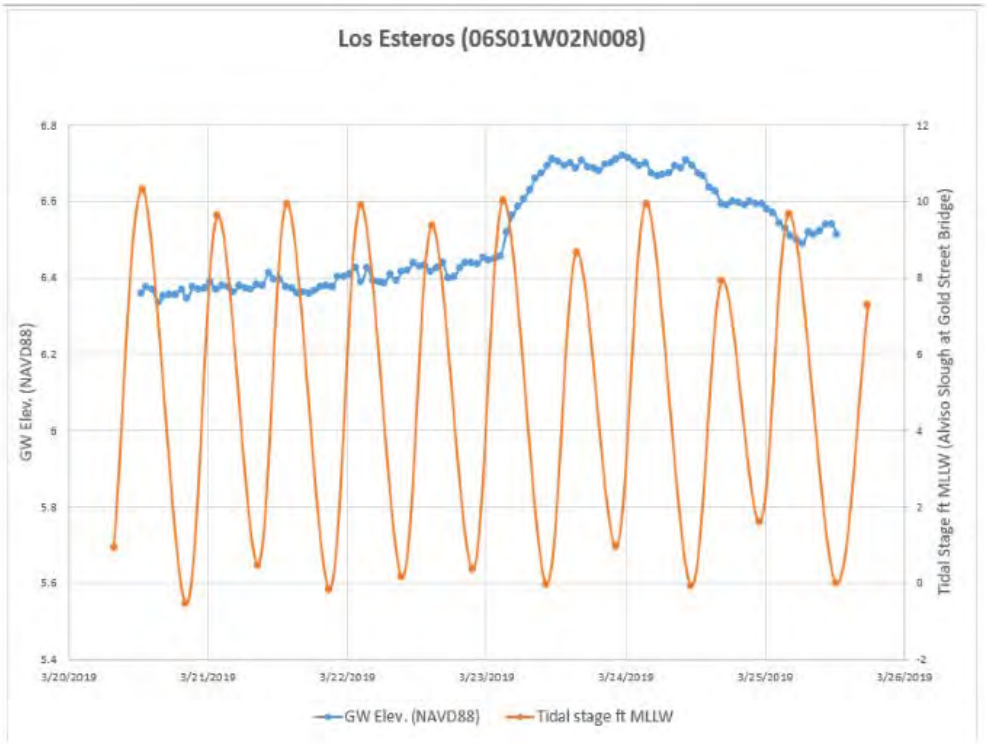
7) Singaraja, C., Chidambaram, S., and Jacob, N., 2018, *A study on the influence of tide on the water table conditions of the shallow coastal aquifers*. N. Appl Water Sci, 8: 11. https://doi.org/10.1007/s13201-018-0654-5

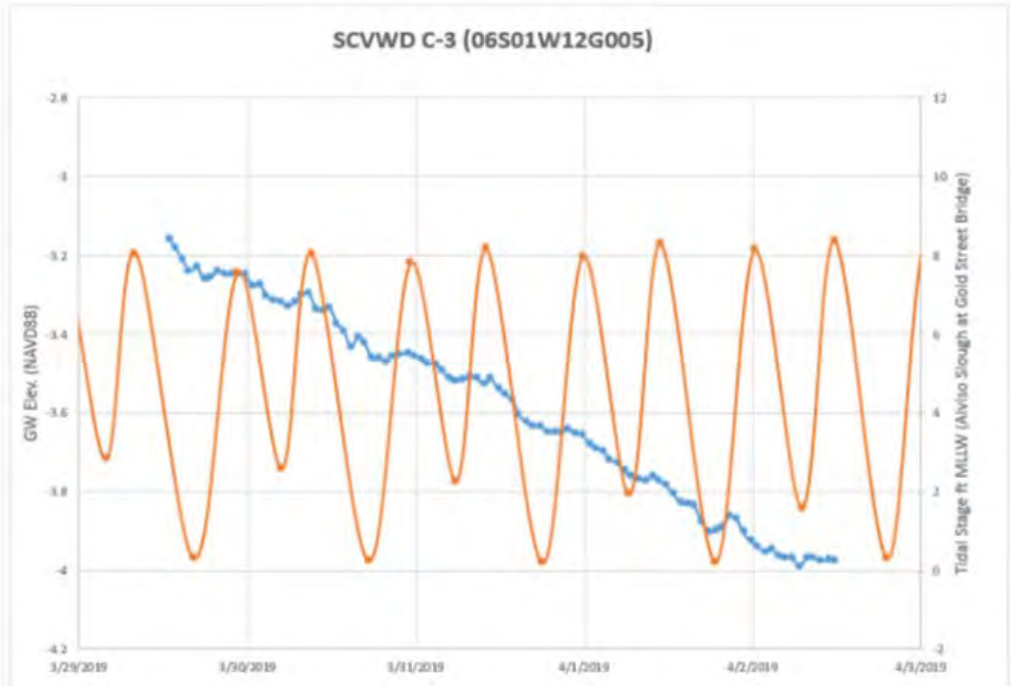
8) U.S. Army Corps of Engineers, 1999, *Environmental Impact Statement for the Disposal and Reuse of Oakland Army Base, Oakland California, September 1999*.

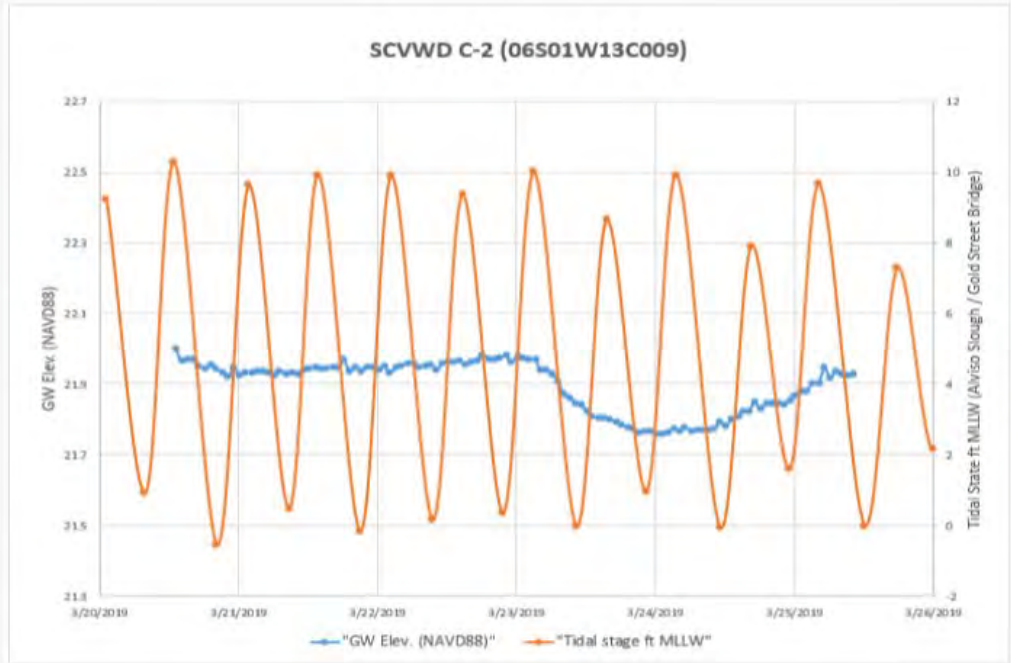
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations
(Note, the vertical axis representing groundwater elevation in all hydrographs is an order-of-magnitude smaller than the tidal stage axis.)



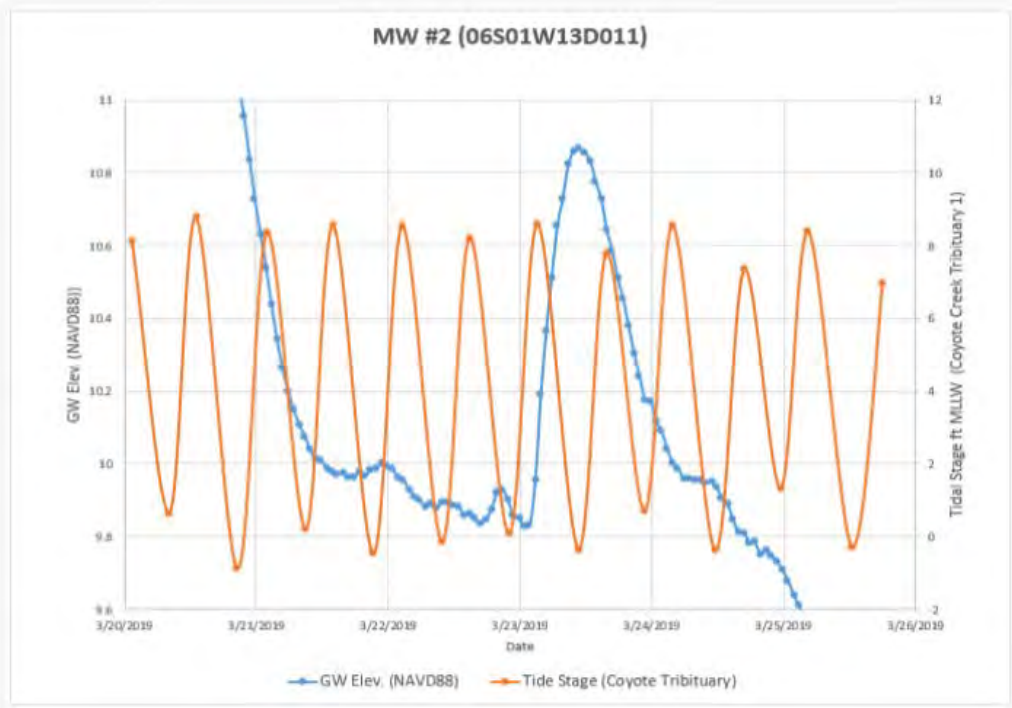


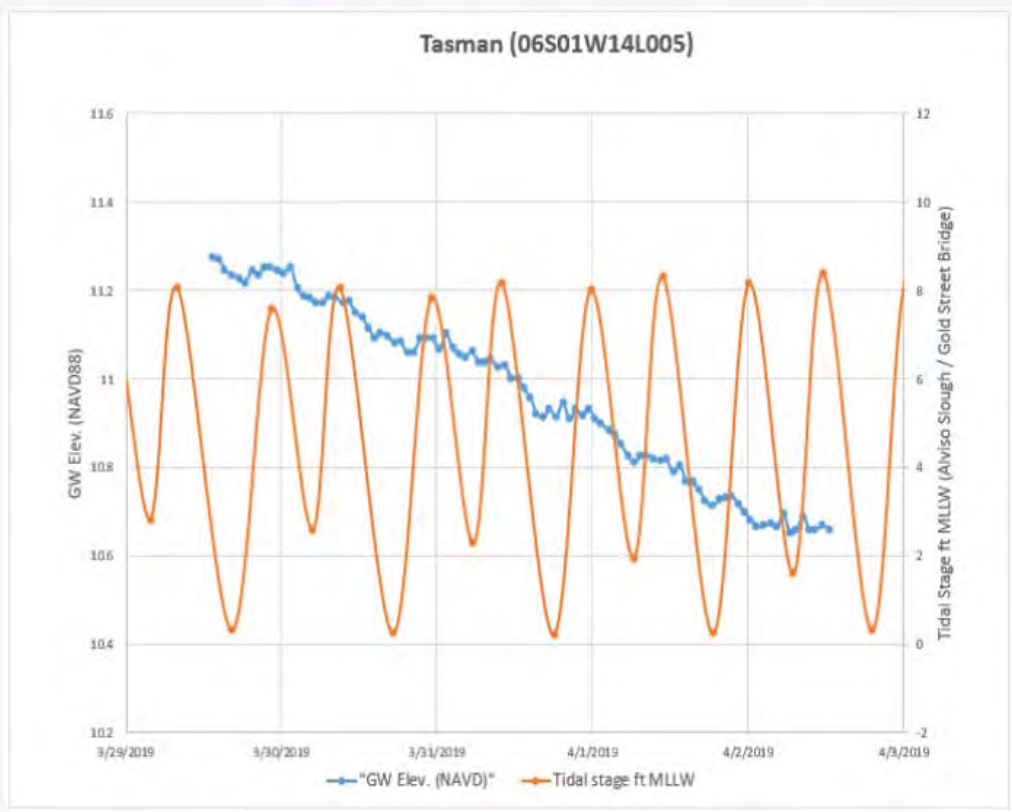
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued



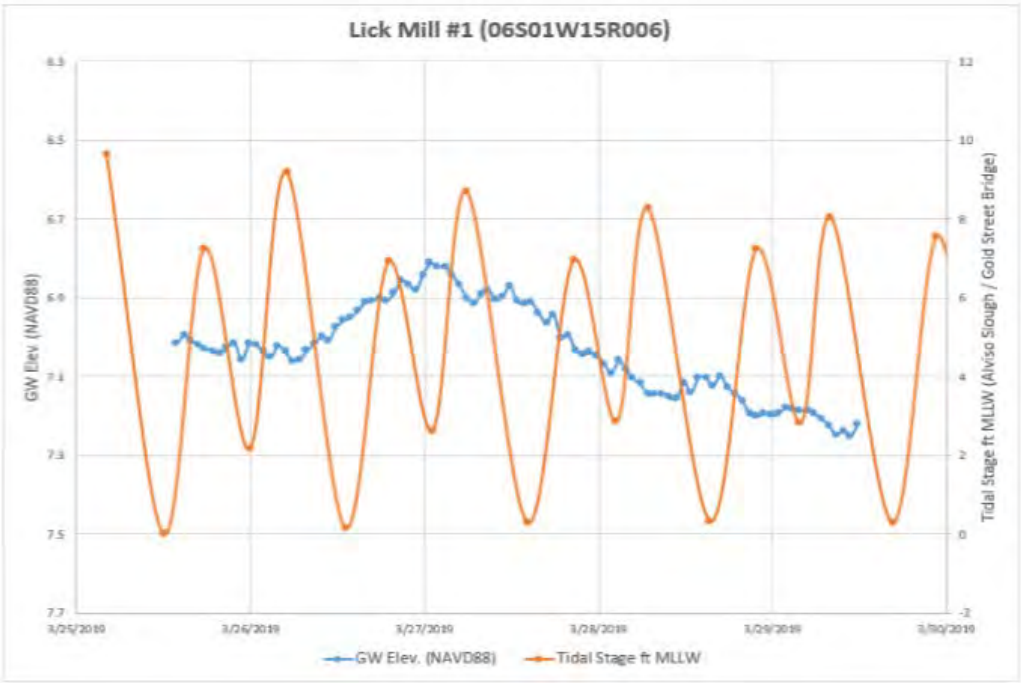


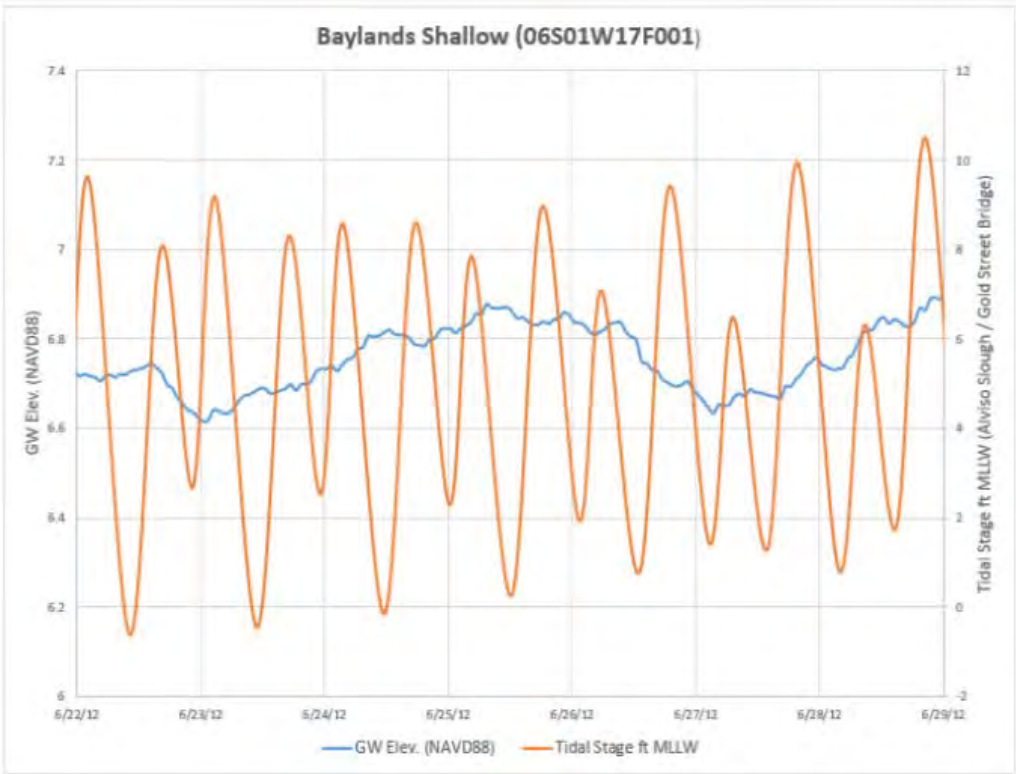
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued





Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued





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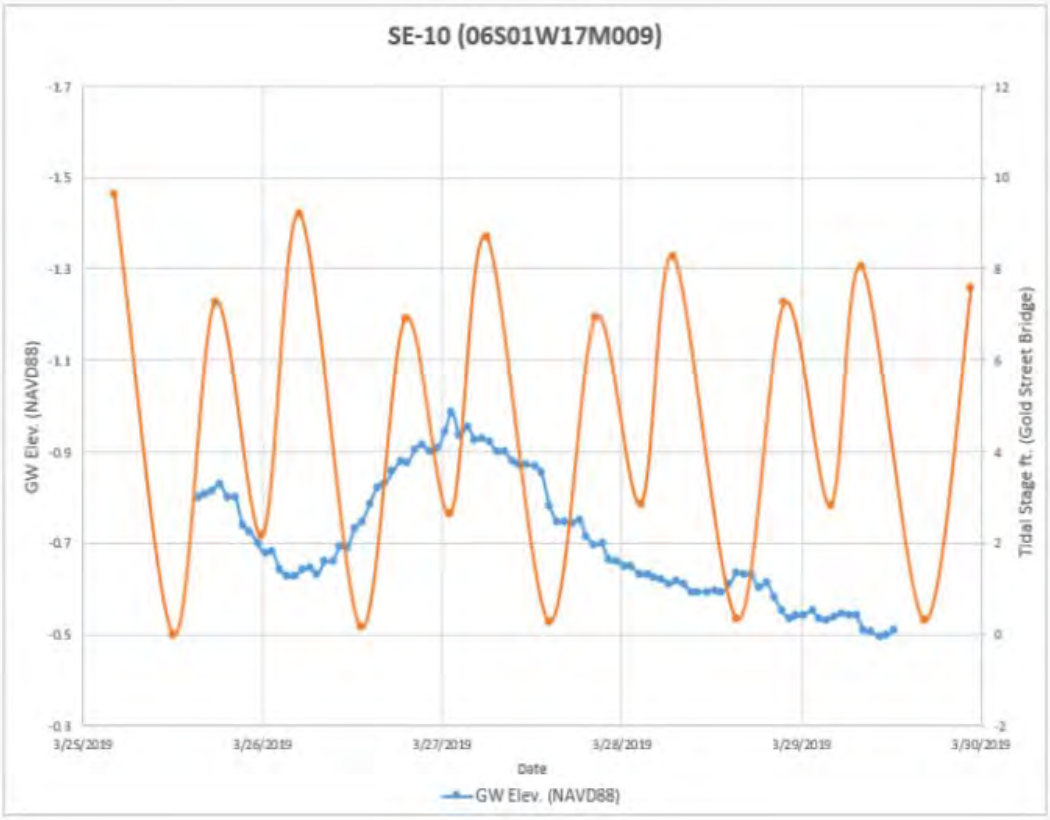

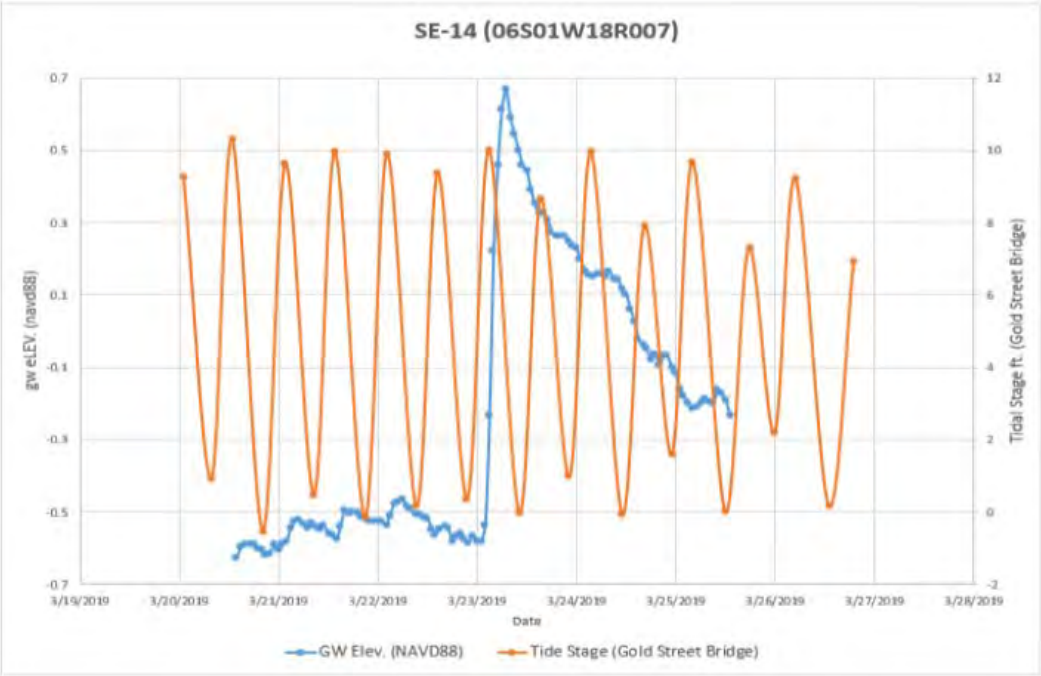

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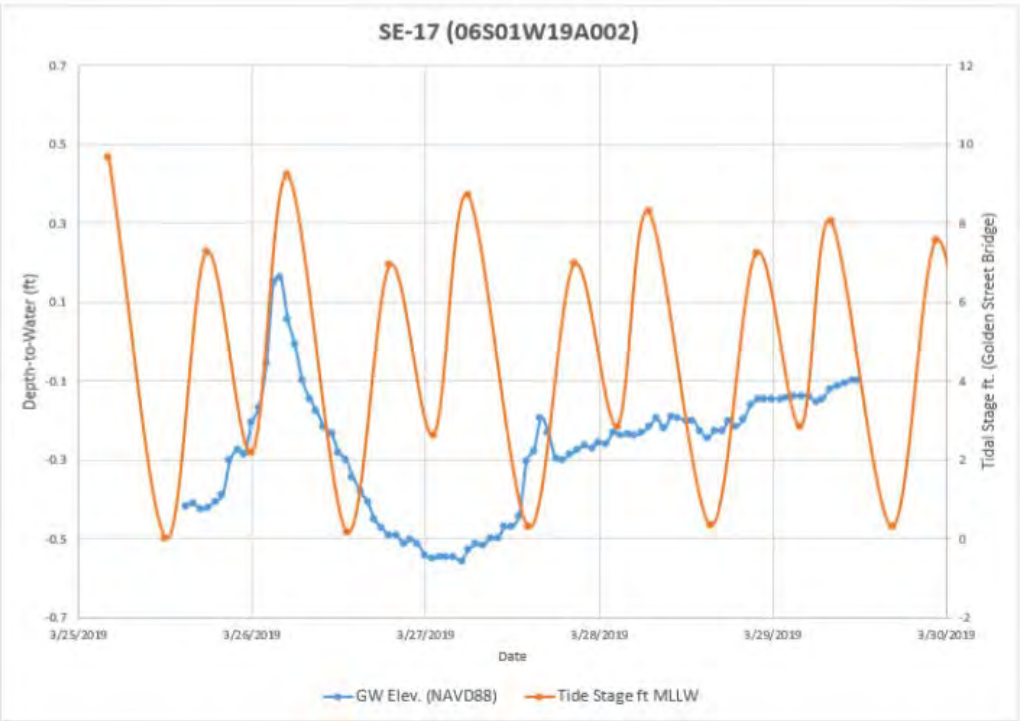
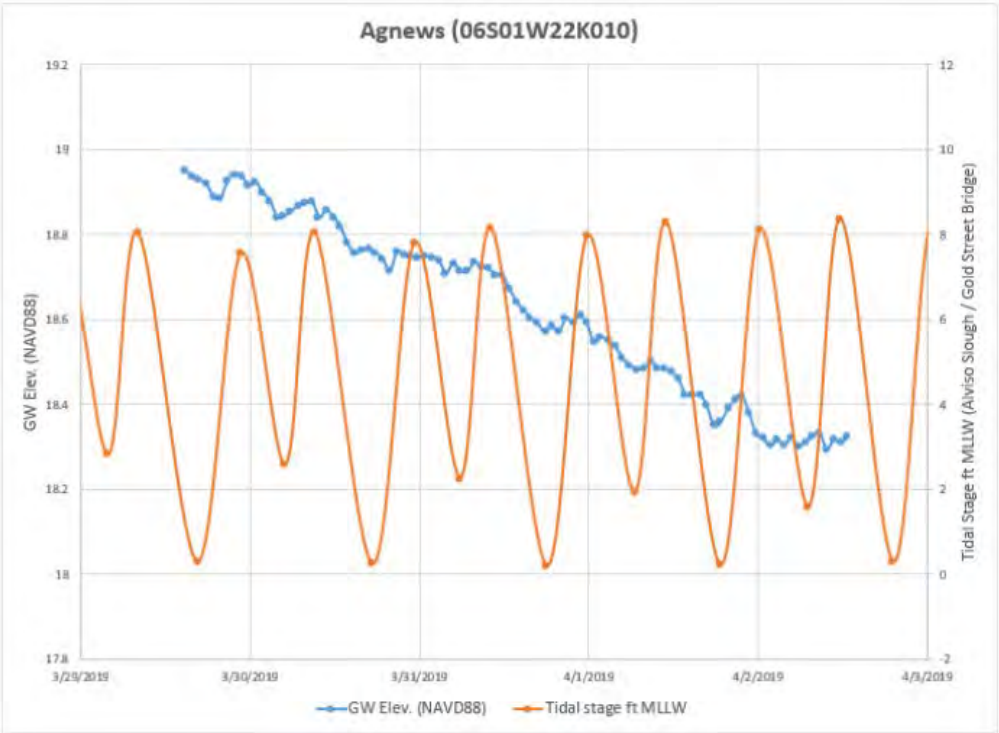
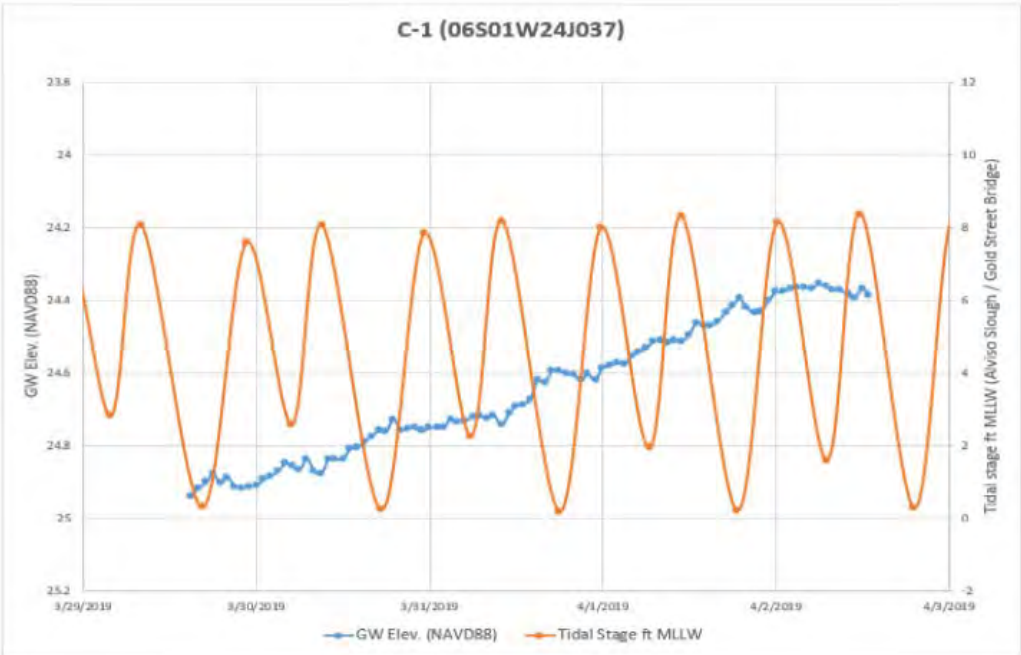
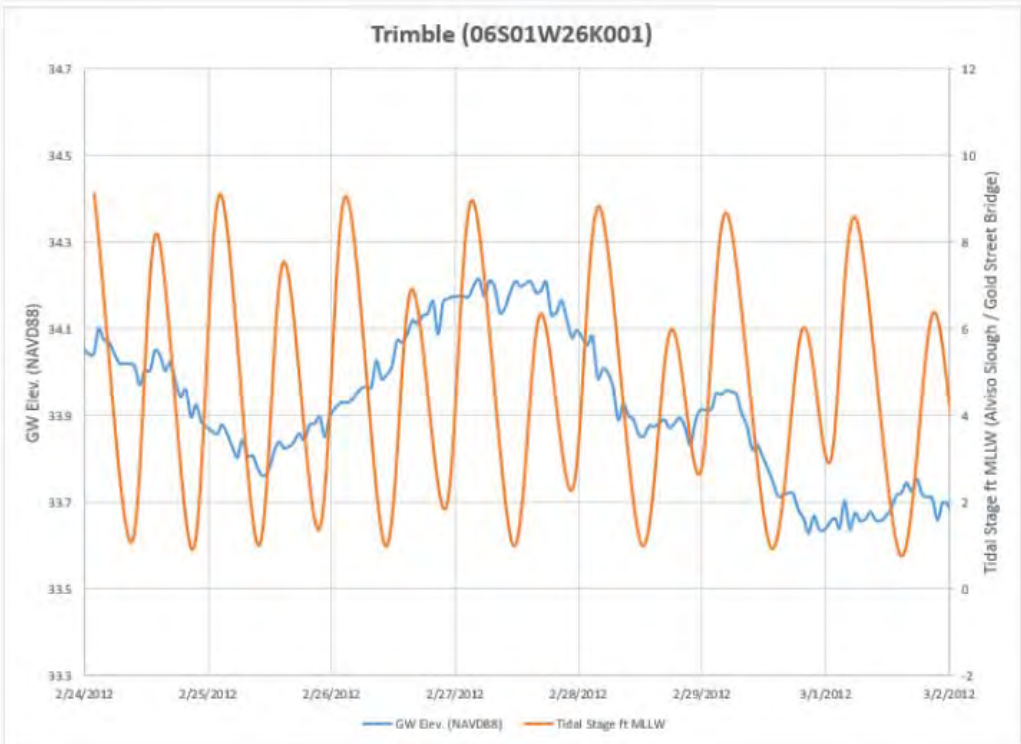


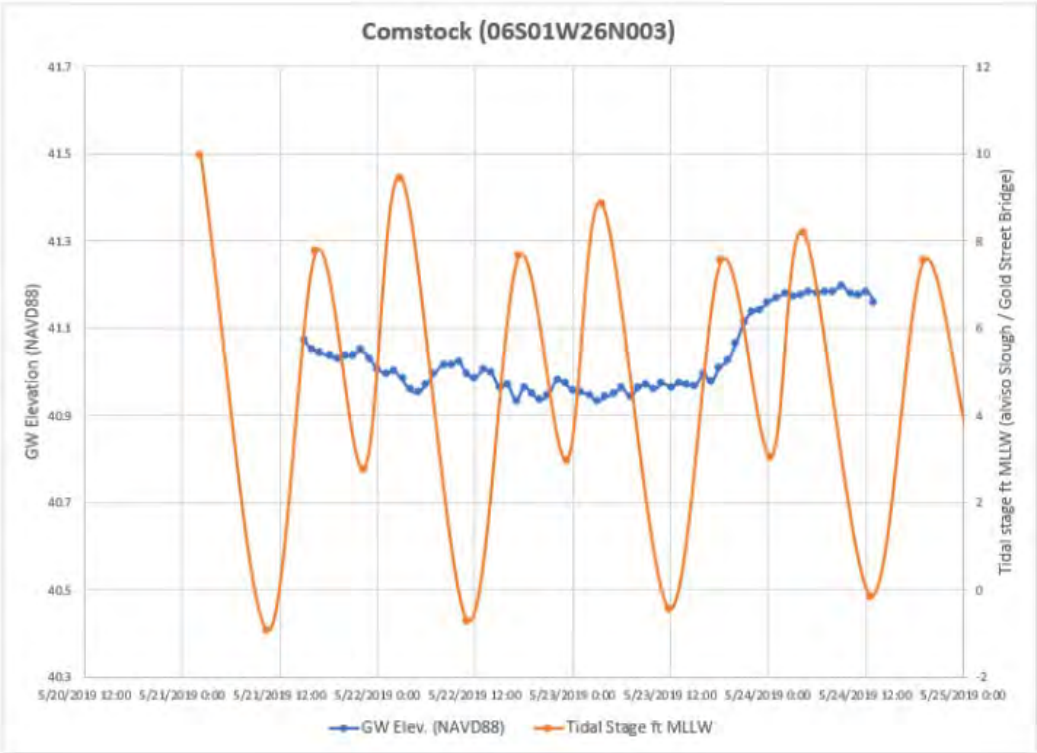


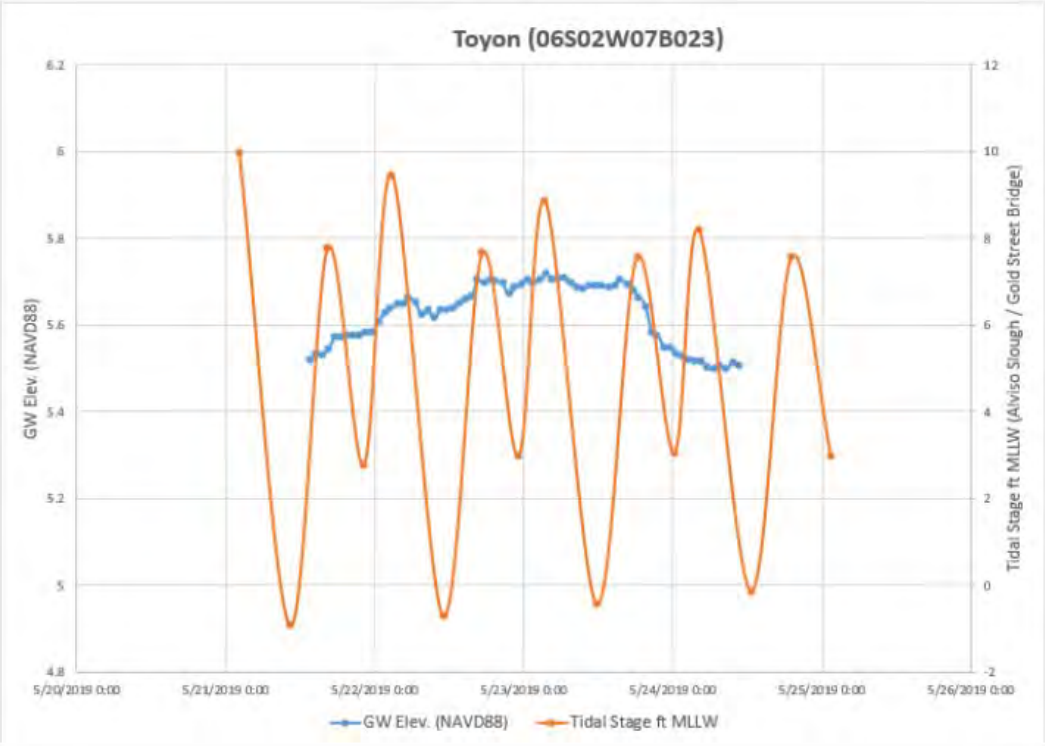
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued



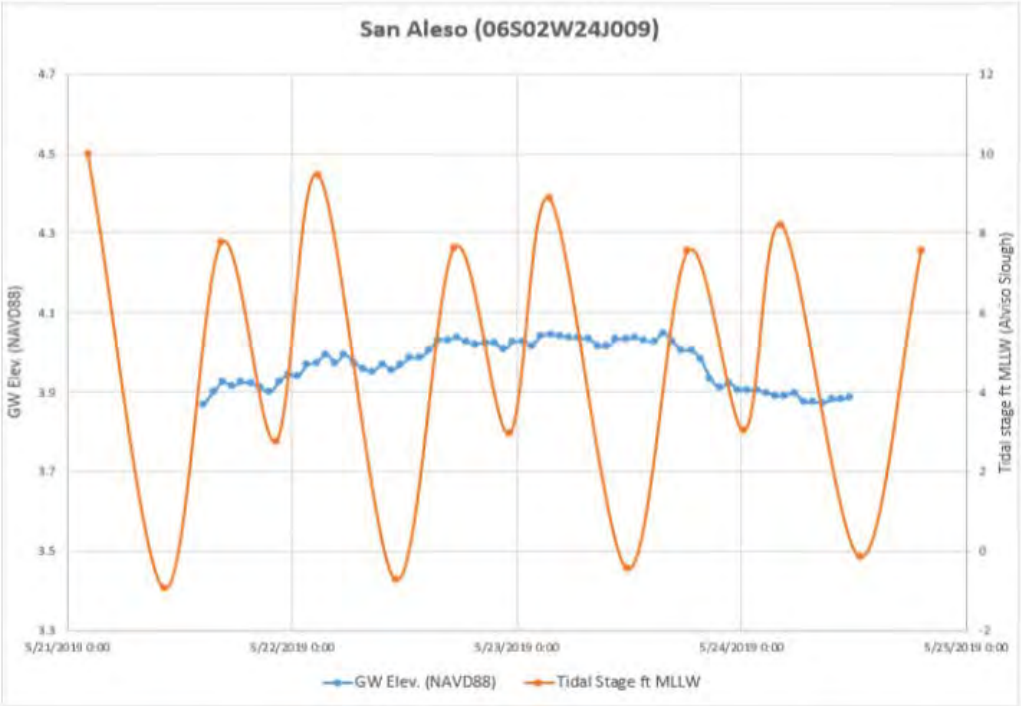


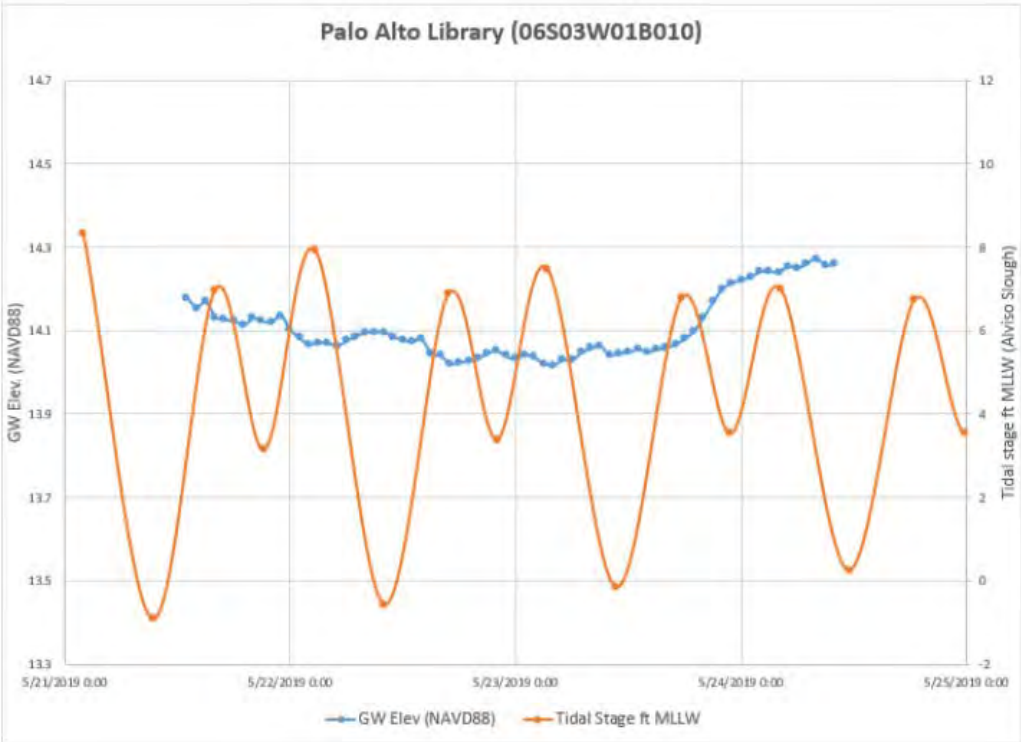
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued





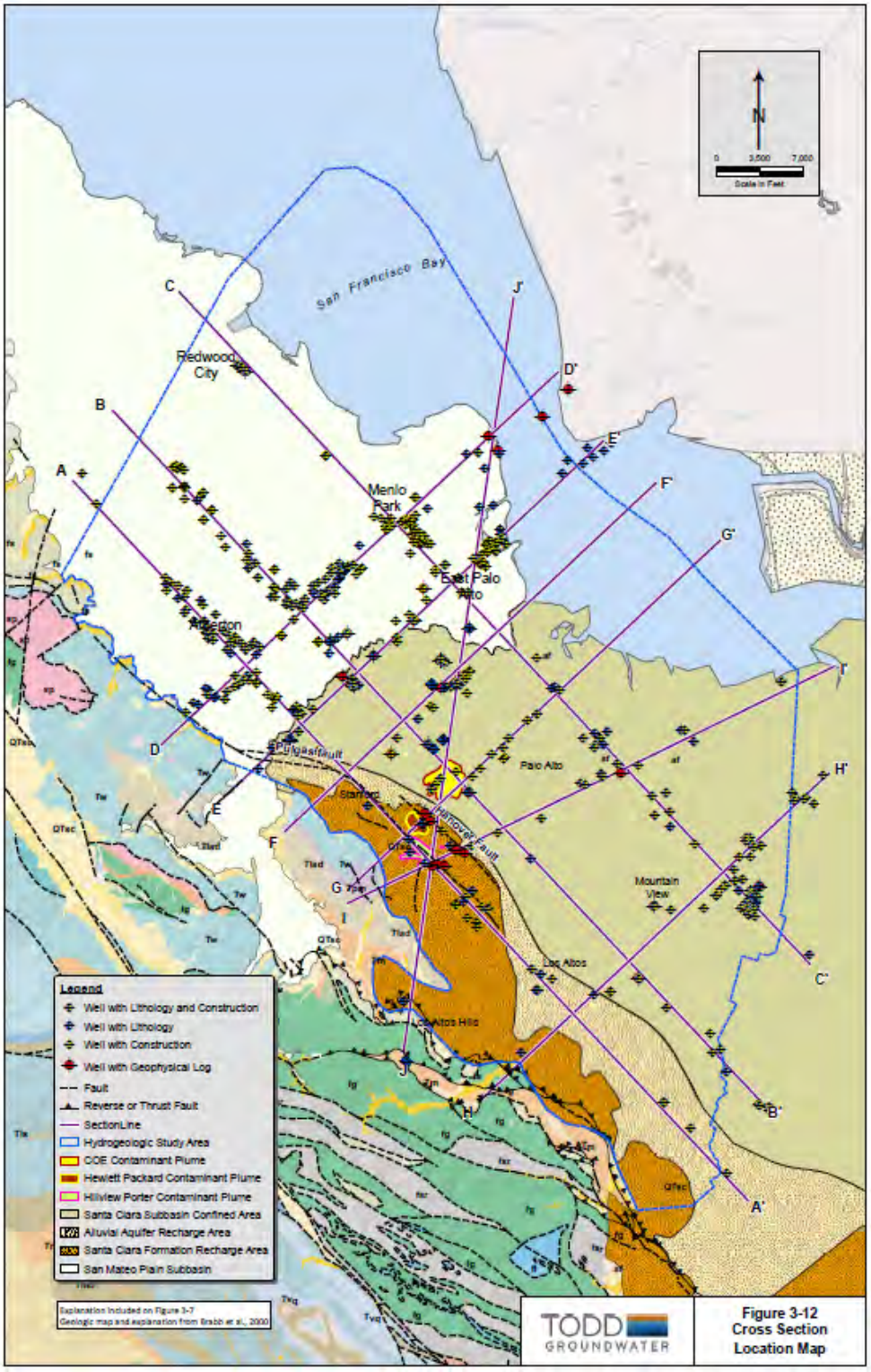
Appendix A. Hydrographs of wells with no apparent response to tidal fluctuations – Continued



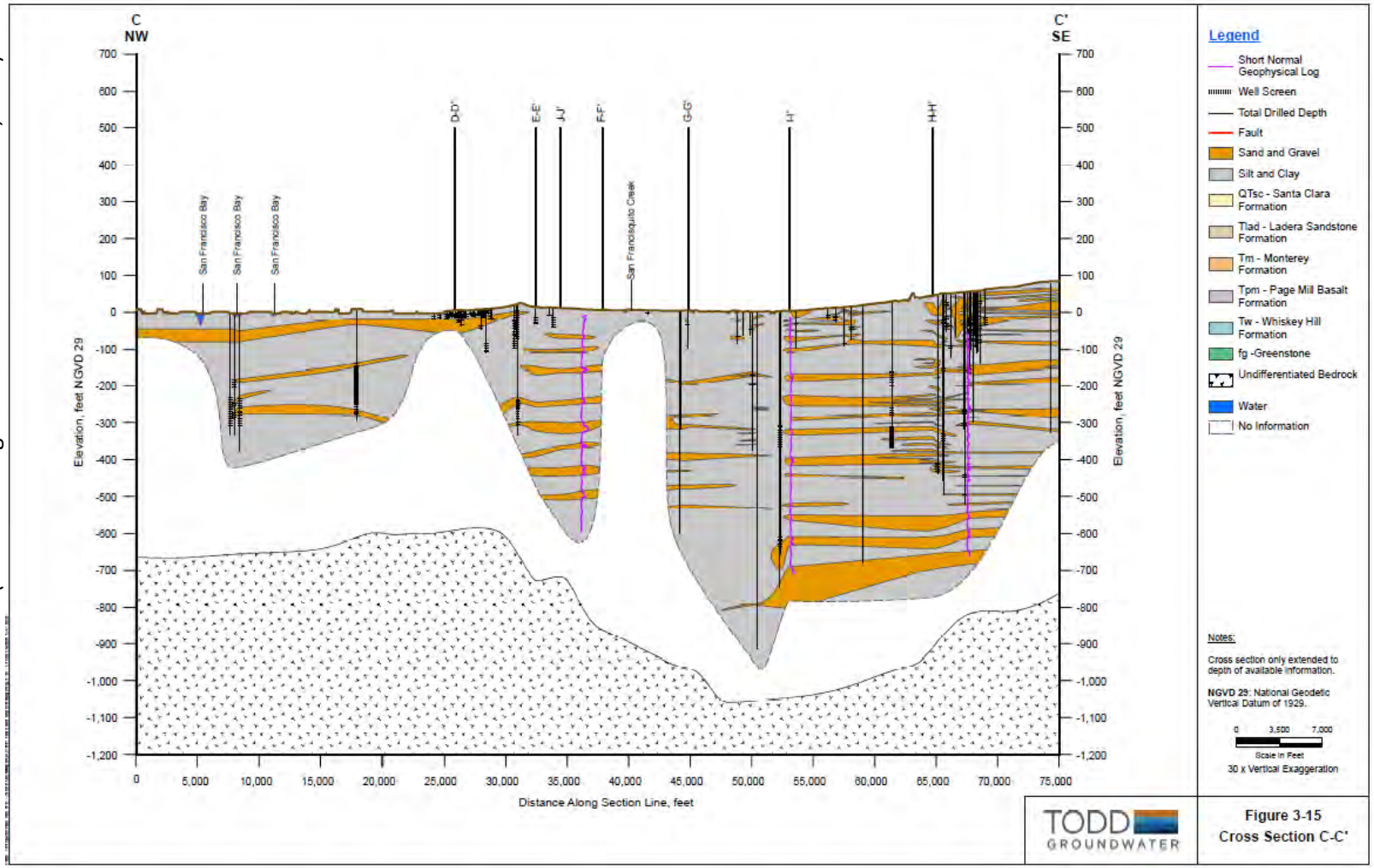


Appendix H-2 – Geologic logs and cross sections of the Baylands (taken from Todd Groundwater, 2018).

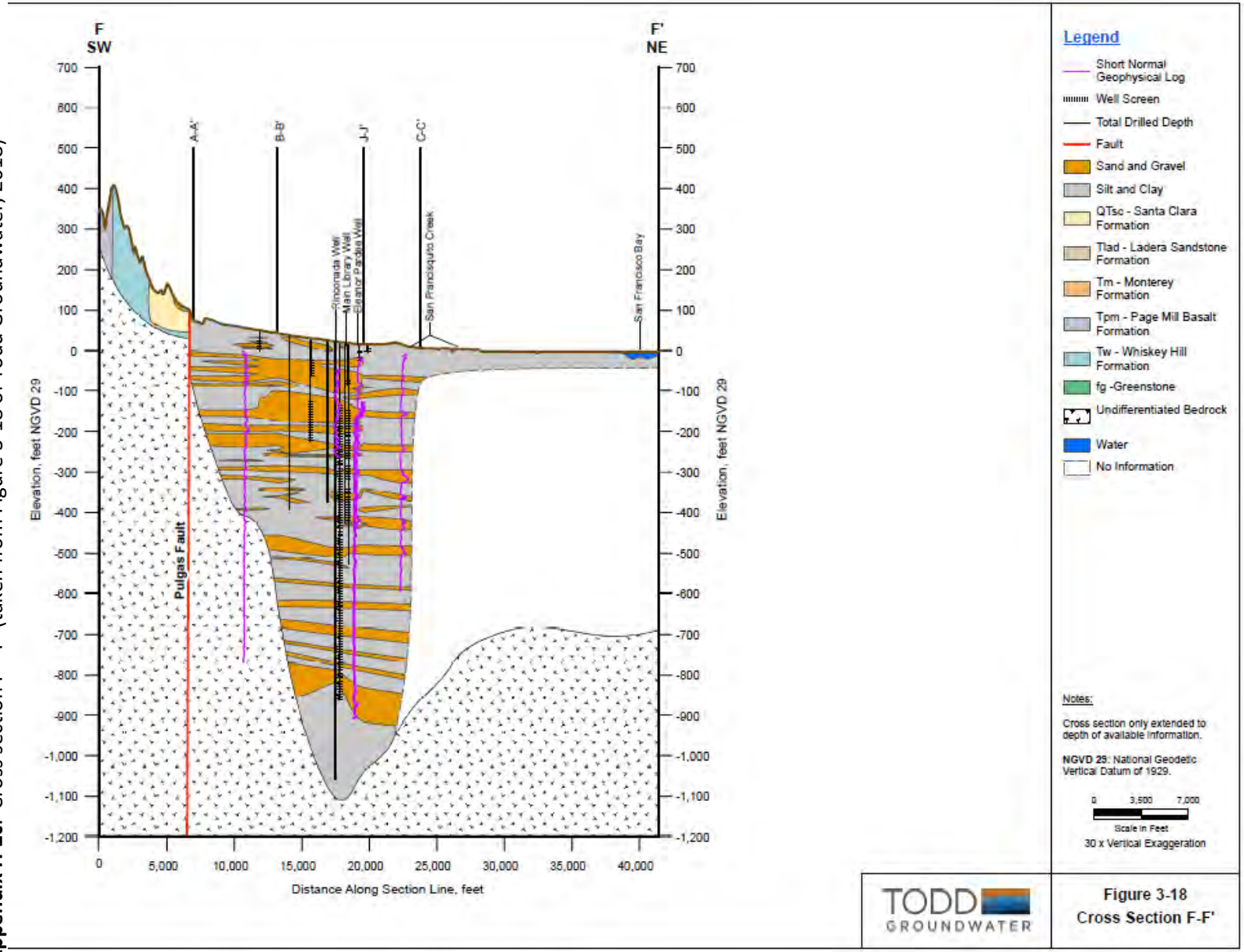
Appendix H-2a. Location of geologic logs and cross sections (taken from Figure 3-12 of Todd Groundwater, 2018)



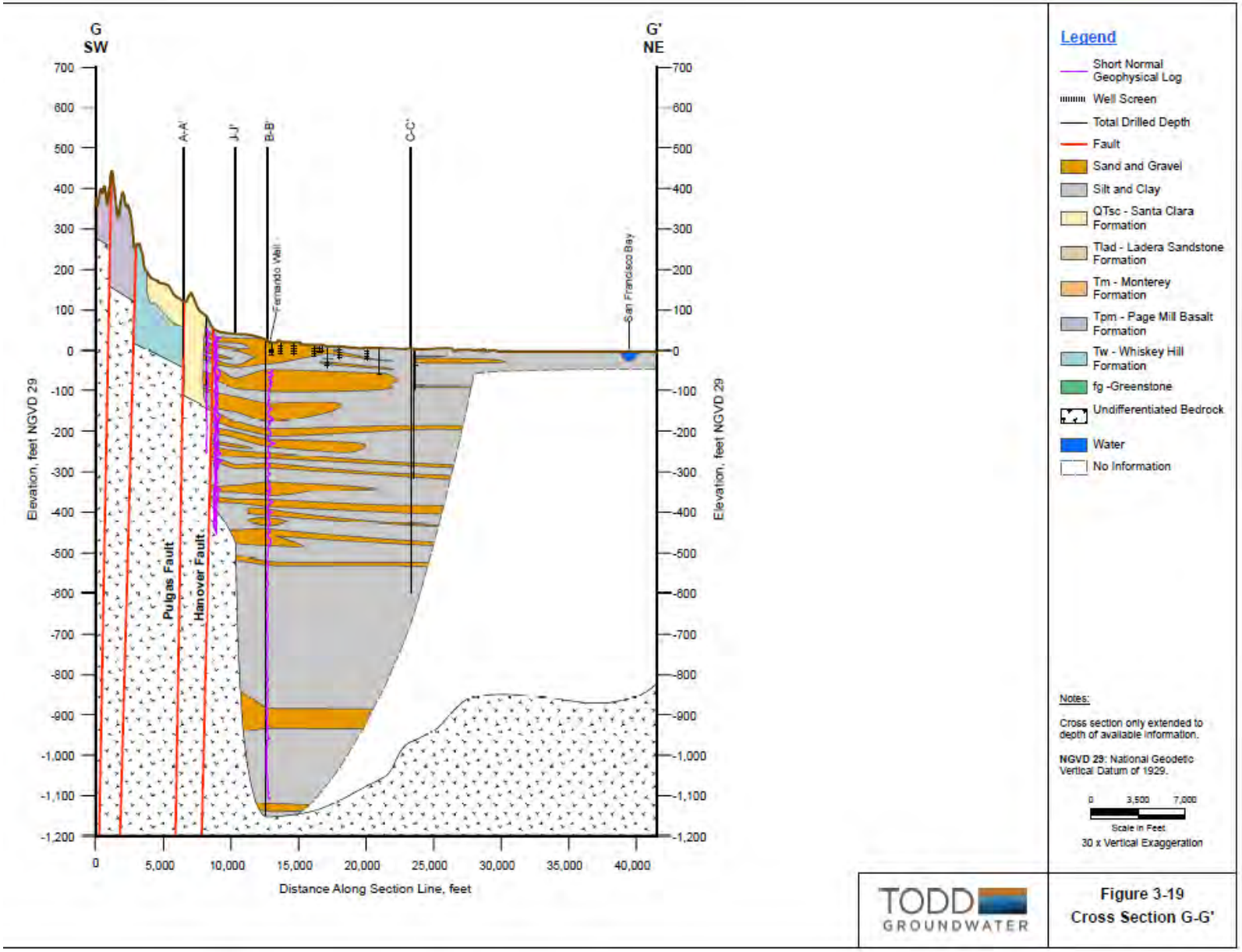
Appendix H-2b. Cross section C – C' (taken from Figure 3-15 of Todd Groundwater, 2018)



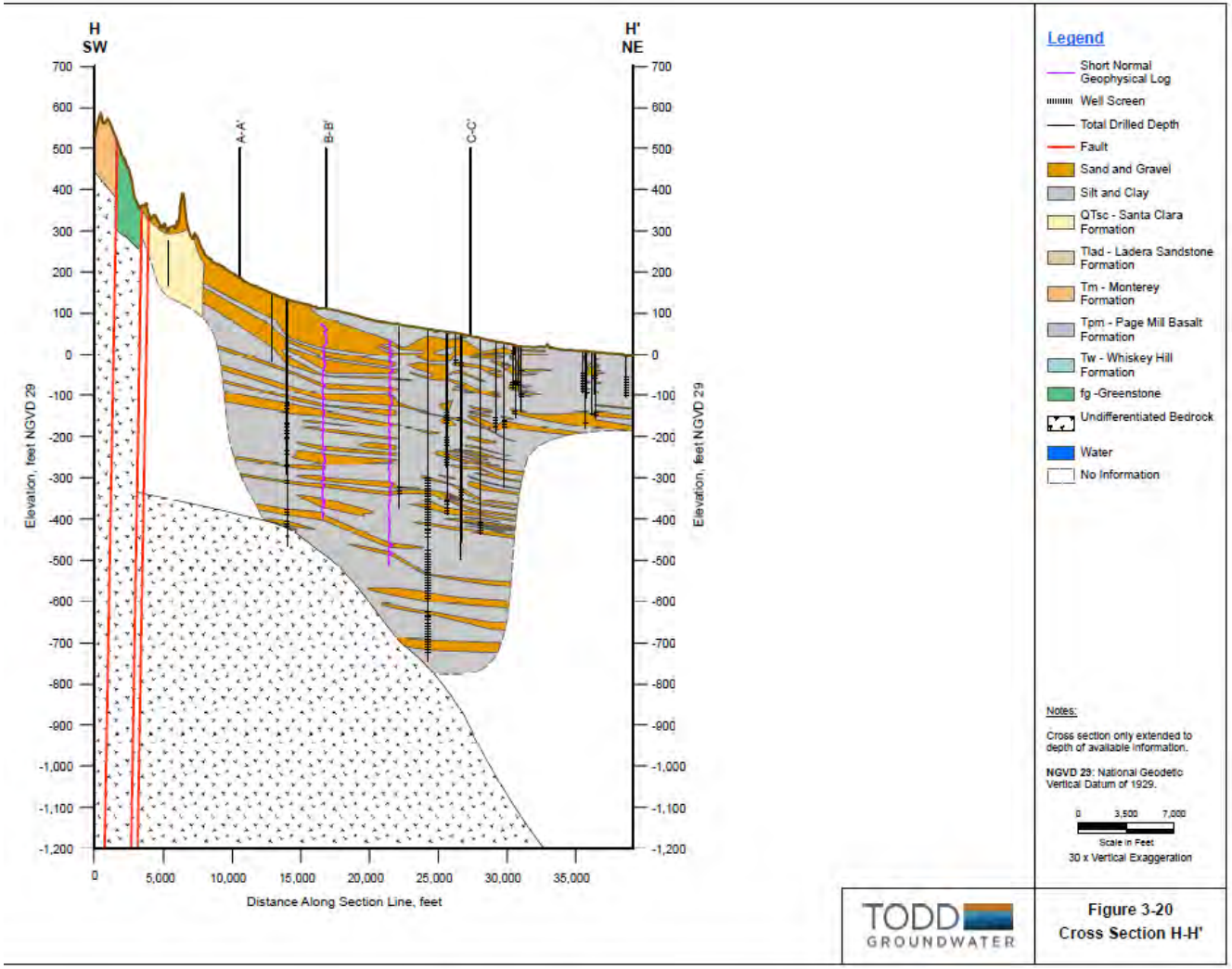
Appendix H-2c. Cross section F – F' (taken from Figure 3-18 of Todd Groundwater, 2018)



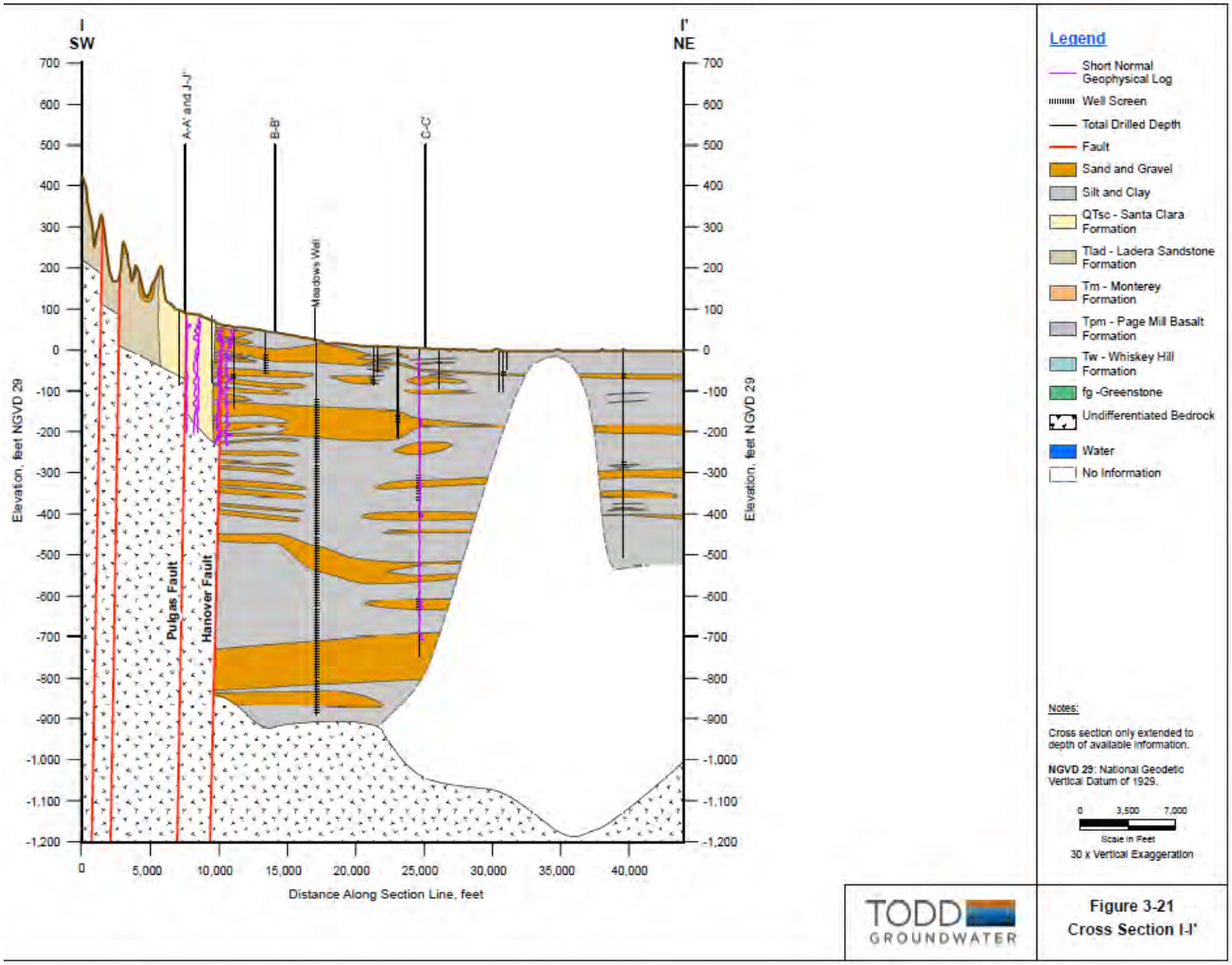
Appendix H-2d. Cross section G – G' (taken from Figure 3-19 of Todd Groundwater, 2018)



Appendix H-2e. Cross section H – H' (taken from Figure 3-20 of Todd Groundwater, 2018)



Appendix H-2f. section I – I' (taken from Figure 3-21 of Todd Groundwater, 2018)



Appendix I – Valley Water Managed Recharge Facilities

Valley Water's managed recharge program uses both surface water runoff captured in local reservoirs and imported water delivered by the raw water conveyance system to recharge the groundwater subbasins in Santa Clara County through more than 277 acres of managed recharge ponds and 91 miles of local creeks. There are a total of 102 managed recharge ponds, including 101 off-stream and one instream pond (Coyote Percolation Pond).

The recharge facilities have been organized into seven systems based on watersheds, as described below (Table I-1). The facilities have been sorted in this way to simplify describing management of a complex and interconnected network. These systems are not independent, but rather share sources of supply and many systems recharge the same groundwater subbasins. Water recharged in one system may be extracted many miles away. The following seven recharge systems are organized here by the new groundwater benefit zones (Tables I-1) that were Board adopted on April 28, 2020 and went into effect on July 1, 2020. The facilities within each Valley Water recharge system and the associated recharge capacity are shown in Table II-1. Table I-2 provides a summary of in-stream and off-stream recharge capacity for groundwater benefit zones W2, W5, W7, and W8.

Penitencia Recharge System

The Penitencia recharge system has a recharge capacity of approximately 6,800 AF per year, which includes 2,200 AF (32%) as in-stream recharge and 4,600 AF (68%) as off-stream recharge ponds (Table I-1). This small system is predominately served by imported water from the SWP, although local water from the Penitencia Creek Watershed also contributes to in-stream recharge in Penitencia Creek and the Overfelt and Mabury ponds. The other facilities in the system, which exclusively recharge SWP water, include the Dr. Robert W. Gross, Piedmont, Helmsley, Capitol, City Park, and County Park ponds. This system recharges the Santa Clara Plain in Zone W2 (Table I-1). Recharge operations have been conducted in this system since 1934.

Los Gatos Recharge System

The Los Gatos recharge system has a recharge capacity of approximately 29,700 AF per year, which includes 5,800 AF (20%) as in-stream recharge and 23,900 AF (80%) as off-stream recharge ponds (Table I-1). The major features of this system include Lexington and Vasona Reservoirs, Los Gatos Creek in-stream recharge, and several off-stream systems including Page, Budd Ave, Sunnyoaks, Camden, McGlincy, and Oka ponds. Most of the source water for this system is from the Los Gatos Creek Watershed in the Santa Cruz Mountains, although imported water from SWP and CVP is also delivered to the system through Valley Water's Central Pipeline. This system recharges the Santa Clara Plain in Zone W2 (Table I-1). Recharge operations have been conducted in this system since 1934.

West Side Recharge System

The West Side recharge system has a recharge capacity of approximately 15,200 AF per year, which includes 13,500 AF (89%) as in-stream recharge and 1,700 AF (11%) as off-stream recharge ponds (Table I-1). Major facilities in the system include Stevens Creek Reservoir, the McClellan off-stream ponds, and the various streams receiving water from the Stevens Creek Pipeline including Regnart, Calabazas, Rodeo, Saratoga, Wildcat, San Tomas, Smith, and Stevens Creeks. In addition to local water from the West Side watersheds, imported water from SWP and CVP is delivered to the system using the Stevens Creek Pipeline. This system recharges the Santa Clara Plain in Zone W2 (Table I-1). Recharge operations have been conducted in this system since 1935.

Guadalupe Recharge System

This system has a recharge capacity of approximately 25,100 AF per year, which includes 12,400 AF (49%) as in-stream recharge and 12,700 AF (51%) as off-stream recharge ponds (Table I-1). The major features of this system include Almaden, Guadalupe, and Calero Reservoirs; Guadalupe Creek, Guadalupe River, Alamitos Creek, Calero

Creek, and Ross Creek in-stream recharge; and the Los Capitancillos, Alamitos, Kooser, and Guadalupe off-stream ponds. Water can be diverted from Almaden Reservoir to Calero Reservoir via the Almaden-Calero Canal. Local water supplies are developed from the Almaden, Guadalupe, and Calero Watersheds, and imported water from the State Water Project (SWP) and Central Valley Project (CVP) can be diverted into the system via the Cross Valley Pipeline, the Almaden Valley Pipeline, and the Central Pipeline. This system recharges the Santa Clara Plain in Zone W-2 (Table I-1), and water can also be diverted from Calero Reservoir to the Valley Water's surface water treatment plants via the Cross Valley Pipeline. Recharge operations have been conducted in this system since 1932.

Coyote Recharge System

This system has a recharge capacity of approximately 27,000 AF per year, which is 100% in-stream recharge (Table I-1). The major features of this system include Anderson and Coyote reservoirs, Coyote Creek in-stream recharge, and the Coyote percolation pond, which is an in-stream recharge pond. Water sources for this system include imported water and the large Coyote Creek watershed, draining much of the west-facing slope of the Diablo Range. After leaving the hills below Anderson Reservoir, Coyote Creek flows northwest to San Francisco Bay, recharging both the Coyote Valley and Santa Clara Plain groundwater management areas (Table I-1, Zone W2). Imported water from San Luis Reservoir via the Santa Clara Conduit is a major water source for the Coyote Recharge System where CVP water provided over half of all water between 2009 and 2018. Imported water can be stored in Anderson Reservoir using the Anderson Force Main, and later released to Coyote Creek or diverted to the Cross Valley Pipeline for recharge elsewhere or as a water supply source for Valley Water's surface water treatment plants. Recharge operations have been conducted in this system since 1934. Through the Main Avenue Pipeline, water from Anderson Reservoir can also be diverted south into the Upper Llagas Recharge System recharging the Llagas Subbasin (Table I-1, Zone W5).

Upper Llagas Recharge System

The Upper Llagas recharge system has a recharge capacity of approximately 18,500 AF per year, which includes 11,100 AF (60%) as in-stream recharge and 7,400 AF (40%) as off-stream recharge ponds (Table I-1). Major facilities include Llagas in-stream recharge, the Madrone Channel, and the San Pedro and Main Avenue ponds. This system recharges the Llagas Subbasin in Zones W5 and W8 (Table I-1), predominately with imported CVP water. Recharge operations have been conducted in this system since 1955.

Lower Llagas Recharge System

The Lower Llagas recharge system has a recharge capacity of approximately 21,200 AF per year, which includes 13,900 AF (66%) as in-stream recharge and 7,300 AF (34%) as off-stream recharge ponds (Table I-1). Major facilities in the system include Uvas and Chesbro Reservoirs, in-stream recharge in Llagas and Uvas Creeks, the Church off-stream ponds, and the Uvas-Llagas pipeline that can divert water from Uvas Reservoir to Llagas Creek. This system is entirely dependent on local water from the Uvas and Llagas Watersheds and recharges the Llagas Subbasin in Zones W5 and W8 (Table I-1). Recharge operations have been conducted in this system since 1955.

Appendix I – Valley Water Managed Recharge Facilities

Table I-1. Valley Water Managed Recharge Facilities

Groundwater Benefit Zone	Recharge System	In-Stream Recharge (Creeks)	Annual Creek Recharge Capacity (AF)[1]	Off-Stream Recharge (Ponds)	Annual Pond Recharge Capacity (AF)[1]
Zone W2	Penitencia	Upper Penitencia Creek	2,200		
				Dr. Robert W. Gross Ponds	3,100
				Piedmont	
				City Park Pond	
				Helmsley	
				Mabury	
				County Park Pond	
				Capitol	
				Overfelt Ponds	1,500
		Creek Total	**2,200**	**Pond Total**	**4,600**
		Recharge System Total: 6,800			
	Los Gatos	Los Gatos Creek	5,800		
				Page Ponds	5,300
				Budd Ave Ponds	5,000
				Sunnyoaks Ponds	2,200
				Camden Ponds	2,200
				McGlincy Ponds	7,700
				Oka Ponds	1,500
		Creek Total	**5,800**	**Pond Total**	**23,900**
		Recharge System Total: 29,700			
	West Side	Regnart Creek	700		
		Calabazas Creek	2,600		
		Rodeo Creek	700		
		Saratoga Creek	4,400		
		Wildcat Creek	400		
		San Tomas Creek	400		
		Smith Creek[2]	700		
		Stevens Creek	3,600		
				McClellen Ponds	1,700
		Creek Total	**13,500**	**Pond Total**	**1,700**
		Recharge System Total: 15,200			

Appendix I – Valley Water Managed Recharge Facilities

Groundwater Benefit Zone	Recharge System	In-Stream Recharge (Creeks)	Annual Creek Recharge Capacity (AF)[1]	Off-Stream Recharge (Ponds)	Annual Pond Recharge Capacity (AF)[1]
	Guadalupe	Alamitos Creek	2,200		
		Calero Creek	900		
		Guadalupe River	4,200		
		Guadalupe Creek	2,900		
		Ross Creek	2,200		
				Alamitos Ponds	1,500
				Guadalupe Ponds	6,600
				Los Capitancillos Ponds	2,900
				Kooser Ponds	1,700
		Creek Total	**12,400**	**Pond Total**	**12,700**
		Recharge System Total: 25,100			
	Coyote	Lower Coyote Creek	1,500		
		Coyote Percolation Pond[2]	10,900		
Zone W7		Upper Coyote Creek	14,600		
		Creek Total	**27,000**	**Pond Total**	**0**
		Recharge System Total: 27,000			
	Upper Llagas	Madrone Channel[2]	1,945		
Zone W5		Madrone Channel[2]	8,055		
		Tennant Creek	-		
		East Little Llagas	1,100		
				Main Avenue Ponds	2,700
				San Pedro Ponds	4,700
		Creek Total	**11,100**	**Pond Total**	**7,400**
		Recharge System Total: 18,500			
	Lower Llagas	Uvas Creek	7,999		
		Llagas Creek	5,764		
				Church Ponds	7,300
				Pond Total	**7,300**
Zone W8		Uvas Creek	101		
		Llagas Creek	36		
		Creek Total	**13,900**		
		Recharge System Total: 21,200			

1. The annual recharge capacity shown assumes water is available all year and that ponds are in normal operational condition.
2. Includes a flashboard steel dam.

Table I-2. Valley Water Annual Managed Recharge Capacity Summary

Groundwater Benefit Zone	In-Stream Recharge (AF)	Off-Stream Recharge (AF)	Total Recharge (AF)
Zone W2	46,300	42,900	89,200
Zone W5	22,919	14,700	37,619
Zone W7	16,545	-	16,545
Zone W8	136	-	136
Total	75,000	68,500	143,500

APPENDIX J

TECHNICAL MEMORANDUM

GROUNDWATER MONITORING NETWORK GAP ANALYSIS FOR THE 2021 GROUNDWATER MANAGEMENT PLAN

Prepared by:

Jason Gurdak, Ph.D., P.H.
Senior Water Resources Specialist

Victoria Garcia
Associate Water Resources Specialist

Roger Pierno, P.E.
Associate Engineer - Civil

Under the Direction of:

Vanessa De La Piedra, P.E.
Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

October 2021

Executive Summary

This technical memorandum (memo) documents the analysis of gaps and redundancies (referred here as the 'gap analysis') in Valley Water's existing groundwater monitoring networks. The gap analysis was recommended as part of the 2016 Groundwater Management Plan (GWMP) and is completed as part of the 2021 GWMP. The primary purpose of this memo is to compile, inventory, and map the locations of the existing groundwater monitoring networks, and identify any gaps and redundancies in those networks, as well as outline recommendations to fills gaps or eliminate redundancies. The gap analysis results and recommendations are important because they support Valley Water's basin management strategies that are used to meet the groundwater sustainability goals. Additionally, the gap analysis results and recommendations will be used to meet the eligibility requirements for various California Department of Water Resources (DWR) planning and technical assistance funding opportunities. Results and recommendations summarized in this memo indicate the need to fill several gaps in the groundwater level and quality monitoring networks, with a priority of co-located gaps overlying the shallow and principal aquifer zones, especially in the confined area of the Santa Clara Plain near southern San Francisco Bay. Other recommendations for filling gaps are detailed in this memo. Major findings and recommendations from this memo are summarized in the 2021 GWMP.

1. Introduction

In its long-standing role as the groundwater management agency for the Santa Clara and Llagas subbasins, Valley Water has established comprehensive groundwater monitoring networks that inform water supply operations and long-term planning. Under California's 2014 Sustainable Groundwater Management Act (SGSM), groundwater monitoring programs are required of all Groundwater Sustainability Plans (GSP) or Alternatives. GSP regulations[1] describe how Groundwater Sustainability Agencies (GSAs) shall use data from groundwater monitoring programs to help characterize the basin settings, develop hydrogeologic conceptual models (HCM), develop and calibrate groundwater flow models, calculate groundwater budgets, and to establish and evaluate sustainability indicators and goals, including measurable objectives, minimum thresholds, and undesirable results (DWR, 2017). Whether required under SGMA or any other adaptive groundwater management approach, monitoring is necessary to monitor basin conditions and measure progress toward achieving management goals. To that end, groundwater monitoring networks must provide adequate spatial and temporal collection of multiple datasets, including groundwater levels, water quality, land surface elevation (subsidence), and surface water discharge conditions to demonstrate compliance with GSP regulations (DWR, 2016).

DWR has provided considerable guidance to help GSAs in the development of monitoring networks to provide sustainability indicator data that are of sufficient accuracy and quantity to demonstrate that the groundwater basin is being sustainable managed (DWR, 2016). While GSP regulations prescribe the purpose for monitoring networks, many characteristics of monitoring networks are not prescribed, but rather are designed based on GSA's decisions within the context of local sustainability goals and DWR's guidance. For example, there are no definitive regulations or rules for the density of groundwater management points needed in a basin (DWR, 2016). DWR (2016) states that "…professional judgement will be essential to determining an adequate level of monitoring, frequency, and density based on the Data Quality Objectives and the need to observe aquifer response to high pumping areas, cones of depression, significant recharge areas, and specific projects."

[1] Alternatives to GSPs, such as the 2021 GWMP, are not subject to the specific requirements for GSPs, but must demonstrate functional equivalency.

Consistent with SGMA requirements and DWR guidance, the 2016 GWMP was submitted by Valley Water and approved by DWR as a GSP Alternative for the Santa Clara and Llagas subbasins, in part, because of Valley Water's extensive groundwater monitoring programs. Valley Water's monitoring networks are the product of an adaptive and opportunistic regional data collection effort that has evolved over many decades (GWMP, 2016). The network includes wells installed by Valley Water, existing wells that Valley Water obtained, and privately owned wells that Valley Water monitors. This compilation of wells, along with the constraints of the existing built environment and land use in Santa Clara County, has resulted in a network of monitoring wells that does not have a uniform spatial distribution in all parts of the subbasins. To supplement this network and fill some spatial gaps, Valley Water collects data from water retailers and other public water suppliers.

Valley Water ensures that the monitoring networks provide adequate information to support a comprehensive understanding of groundwater conditions and to inform decision-making. As part of an adaptive management strategy, Valley Water evaluates data gaps and redundancies, monitoring procedures, and associated data management, evaluation, and reporting. While individual wells and analytical parameters may vary or evolve within the networks as part of adaptive management, the groundwater monitoring programs consistently provide high quality and comprehensive data to evaluate groundwater sustainability within the Santa Clara and Llagas subbasins.

2. Purpose and Scope

The overarching purpose of this gap analysis is to help ensure that the monitoring networks provide groundwater data that supports Valley Water's adaptive groundwater management strategy as the GSA for the Santa Clara and Llagas subbasins. The need for this gap analysis was described in the 2016 GWMP as items 4a. and 4.c. in section 8.3 (Groundwater Management Plan Recommendations) as shown below:

> **Maintain adequate monitoring programs and modeling tools.**
>
> The assessment of groundwater conditions and performance of outcome measures relies on timely, accurate, and representative data. The District [Valley Water] has comprehensive groundwater monitoring programs and calibrated groundwater flow models, but they need to be maintained and improved. Priorities include efforts to:
>
> a. Identify gaps and redundancies in existing monitoring networks.
> b. Secure long-term access for sustainable monitoring networks.
> c. Identify additional monitoring needed to improve assessment of basin conditions.
> d. Identify and implement modeling improvements to enhance simulation capabilities, including groundwater storage estimates.
> e. Improve understanding of surface water/groundwater interaction.

While this memo documents the response to recommendations 4.a. and 4.c., other memos and analysis have been completed by Valley Water as part of the 2021 GWMP to respond to the other three recommendations.

Therefore, the primary purpose of this gap analysis memo is to compile, inventory, and map the locations of the existing groundwater monitoring networks, which includes identifying any gaps and redundancies, and recommendations to fills gaps or eliminate redundancies. The gap analysis results and recommendations are important because they support Valley Water's basin management strategies that are used to meet the sustainability goals, specifically basin management strategy #3 to maintain and develop adequate groundwater models and monitoring networks (2016 GWMP, section 5.3). Additionally,

the gap analysis results and recommendations will be used to meet the eligibility requirements for various funding opportunities, including the Sustainable Groundwater Management Act (SGMA) Implementation Grant Program and the California Department of Water Resources (DWR) Technical Support Services program.

The following sections of this memo are organized based on the four major monitoring programs that are documented in Chapter 7 of the 2021 GWMP, including the groundwater level monitoring, land subsidence monitoring, groundwater quality monitoring, and surface water monitoring programs. While each monitoring program has a different purpose and characteristics, the following sections of this memo have similar content and organization that enable both an analysis of each program and comparison across programs. Each of the following sections describe the status of the monitoring program, methods and results of the gaps and redundancy analysis, and relevant recommendations for each program, which may include the analytical parameters, monitoring frequency, well characteristics, and other relevant information.

3. Groundwater Level Monitoring

Accurate and comprehensive groundwater level monitoring is an essential aspect of sustainable groundwater management. Groundwater levels provide information that is needed to assess groundwater storage conditions and trends, which is important for water supply management and planning. Groundwater levels also provide information on groundwater/surface-water interactions, conditions that may result in subsidence, threats to groundwater quality such as seawater intrusion, or nuisance conditions, such as flooding of subsurface infrastructure.

3.1. Regional Groundwater Level Monitoring Program

3.1.1. Background

Valley Water manages the Santa Clara and Llagas subbasins and the associated groundwater system as roughly divided into a deeper, principal aquifer zone and shallow aquifer zone. The principal aquifer zone in the subbasins is generally deeper than 150 feet below land surface (bls) and provides the majority of groundwater used for domestic, municipal, agricultural, and industrial purposes. The shallow groundwater zone is less than 150 feet below land surface and is also an important water source for some groundwater dependent ecosystems (GDEs). As compared to the principal aquifer zone, there is relatively minimal groundwater pumping from the shallow aquifer zone for beneficial uses in most areas of the subbasins. Additional details about the principal and shallow aquifer zones are available in the Basin Setting section of the GWMP (Chapters 2 and 3).

3.1.2. Current Status

Valley Water's groundwater level monitoring program is an extensive network of 229 wells that are screened in the principal and shallow aquifer zones (see Chapter 7.1 of the GWMP). This network was created as the result of both planning and opportunistic acquisitions of wells. As such, the groundwater level monitoring network is spatially extensive but has some gaps that may limit a comprehensive understanding of the entire subbasins. For example, there are areas of the subbasins where monitoring wells are miles apart in the principal aquifers. Additionally, the current monitoring of shallow groundwater, especially near the San Francisco Bay (Bay) and in areas with naturally occurring high groundwater, could be improved to provide a better understanding of this resource, including the interactions between the freshwater and seawater interface and implications for seawater intrusion and GDEs. In addition to gaps, some areas of the subbasins may have redundancies in monitoring wells because of the opportunistic acquisition of wells that provide information about groundwater conditions

that is essentially the same as nearby, existing wells within the network. Therefore, the purpose of this section of the memo is to identify gaps and redundancies within the existing groundwater level monitoring network and to provide recommendations on how to fill those gaps and eliminate redundancies.

3.2. Methods

The groundwater level monitoring network, including gaps and redundances was evaluated using existing well construction data, proximity of wells to one another, and input from Valley Water staff, including the groundwater modelers that rely on groundwater levels for model calibration and verification. A Thiessen polygon analysis was primarily used to identify gaps and redundancies. Using ArcGIS, Theissen polygons were created around each well with similar construction depths within the principal and shallow zones as shown in Figures 1 and 2, respectively. While Valley Water describes shallow and principal aquifer zones within the Santa Clara and Llagas Subbasins as described in Chapters 1 and 2, for the purposes of this analysis, Valley Water also evaluates the very shallow zone as a subset of the shallow aquifer zone. This very shallow portion of the shallow zone relates to wells that are less than 50 feet deep bls (Figure 3), which likely help to monitor groundwater responses to managed aquifer recharge, groundwater and surface-water interactions, and conditions that may influence GDEs or seawater intrusion near the Bay. Thiessen polygons depict the area of influence around each well; relatively large Thiessen polygons indicate relatively large areas of influence, and vice versa for relatively small polygons. Wells that have large areas of influence and great distance between them may indicate spatial gaps in the monitoring network where additional wells may be needed. The Thiessen polygon analysis provides an objective method to assist Valley Water in determining an adequate level of monitoring, frequency, and density for the groundwater level monitoring network.

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Figure 1. Thiessen Polygons for Currently Monitored Principal Aquifer Water Level Wells Polygons

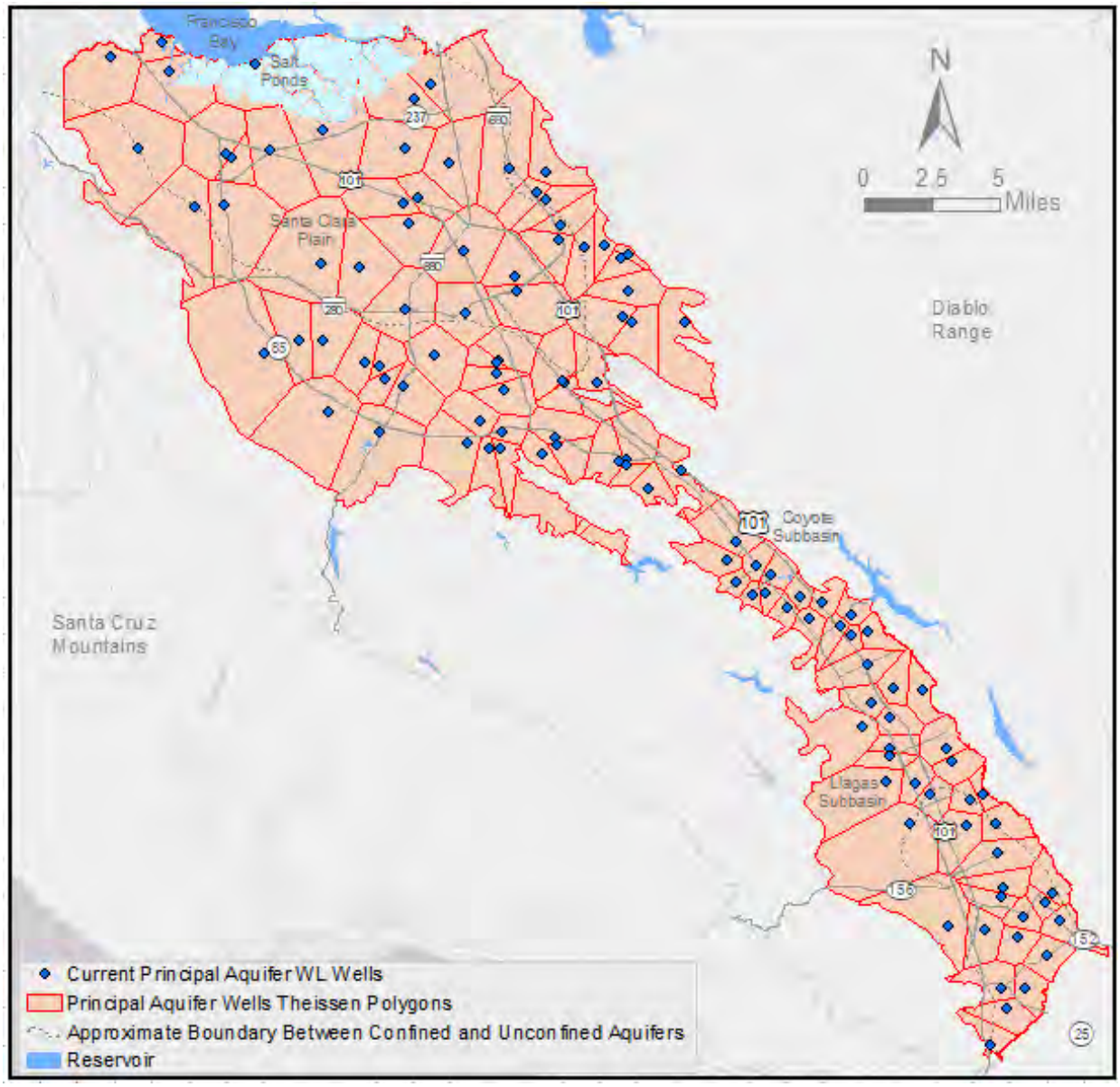

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Figure 2. Thiessen Polygons for Currently Monitored Shallow Aquifer Water Level Wells

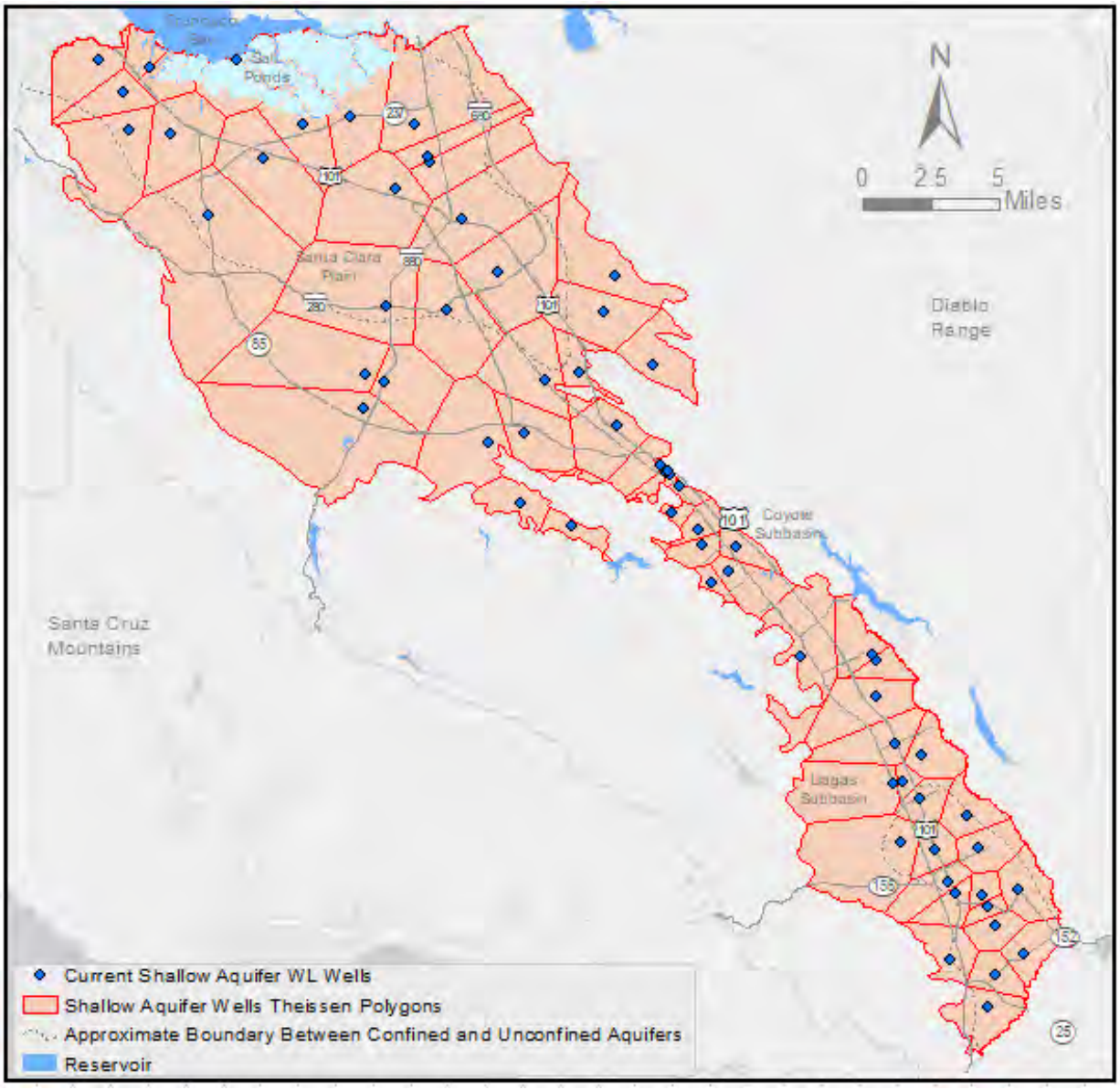

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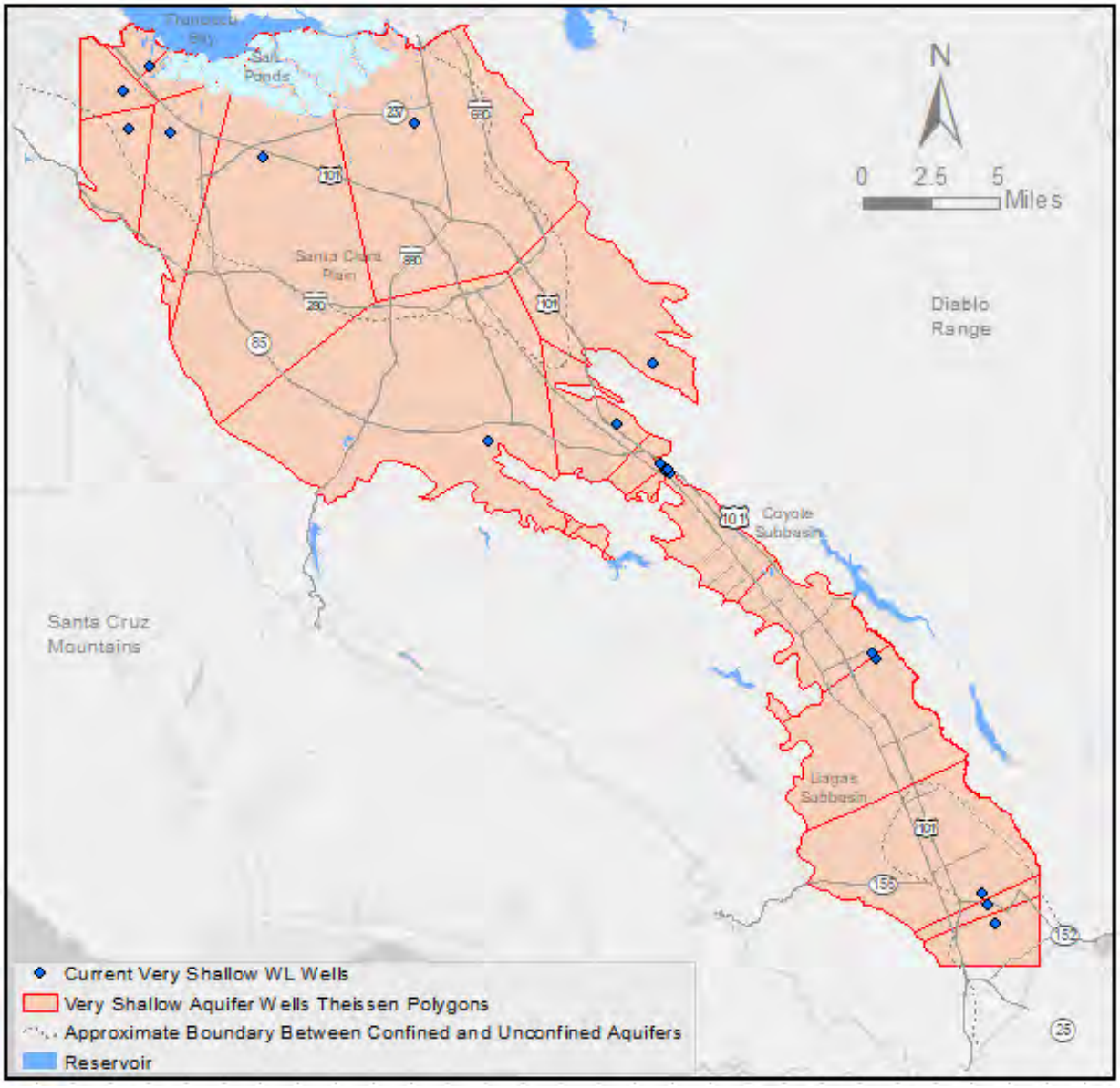
Figure 3. Theissen Polyons for Currently Monitored Very Shallow Aquifer Water Level Wells



3.3. Gap Analysis

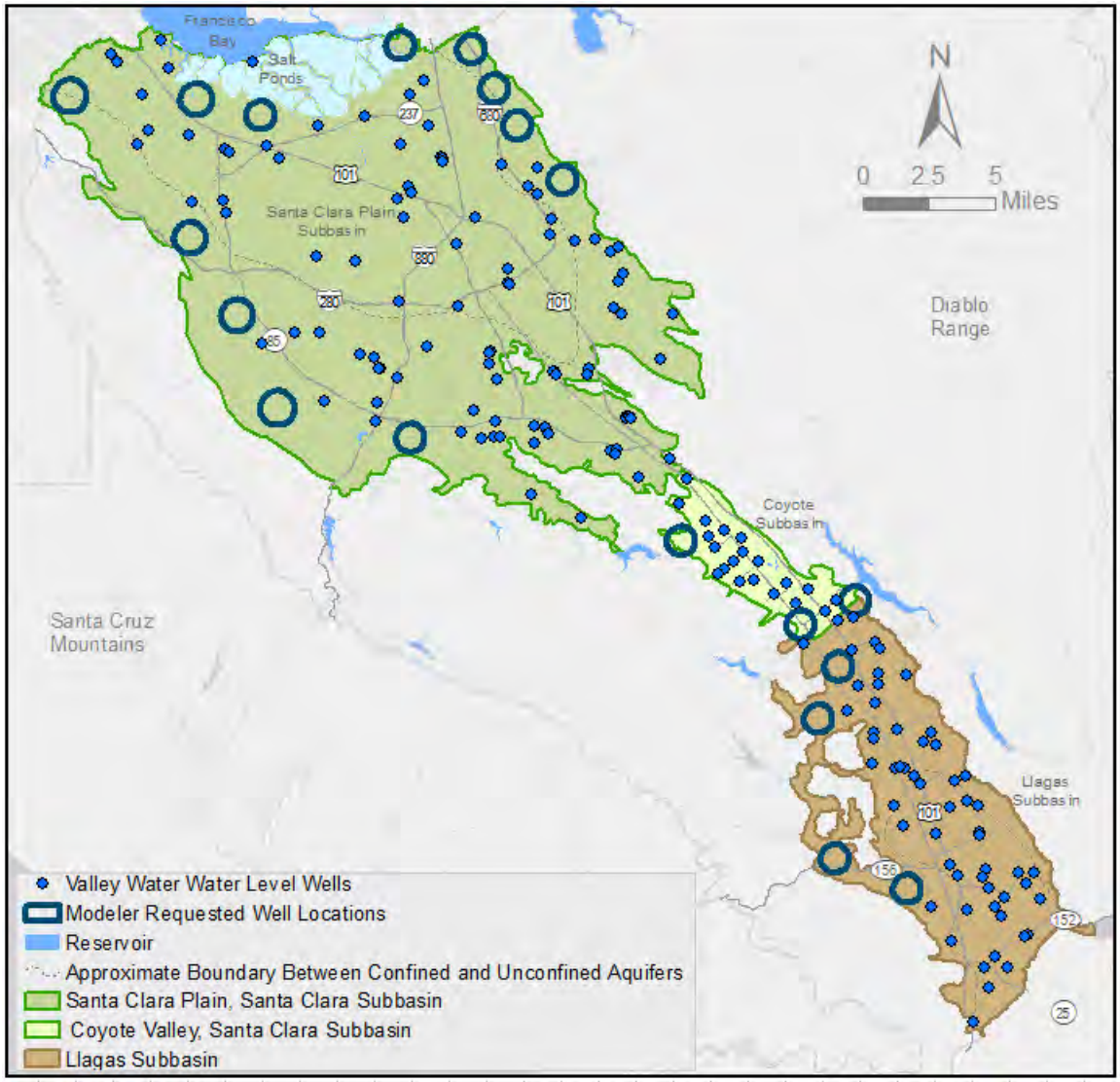
3.3.1. Principal Aquifer Monitoring Wells

Given the principal aquifer depth ranges from about 150 ft to more than 1,000 ft bls, a large number of deep wells are needed to monitor groundwater levels in this aquifer zone. The results of the Thiessen polygon analysis (Figure 1) indicate a uniform and excellent spatial coverage across the majority of the Santa Clara and Llagas subbasins. However, there are some relatively large polygons in the northern and western parts of the Santa Clara Subbasin and along the western edge of the Llagas Subbasin (Figure 1). As discussed below, these large polygons are indicative of spatial gaps in the network.

In addition to the Thiessen polygon analysis (Figure 1), Valley Water groundwater modeling staff

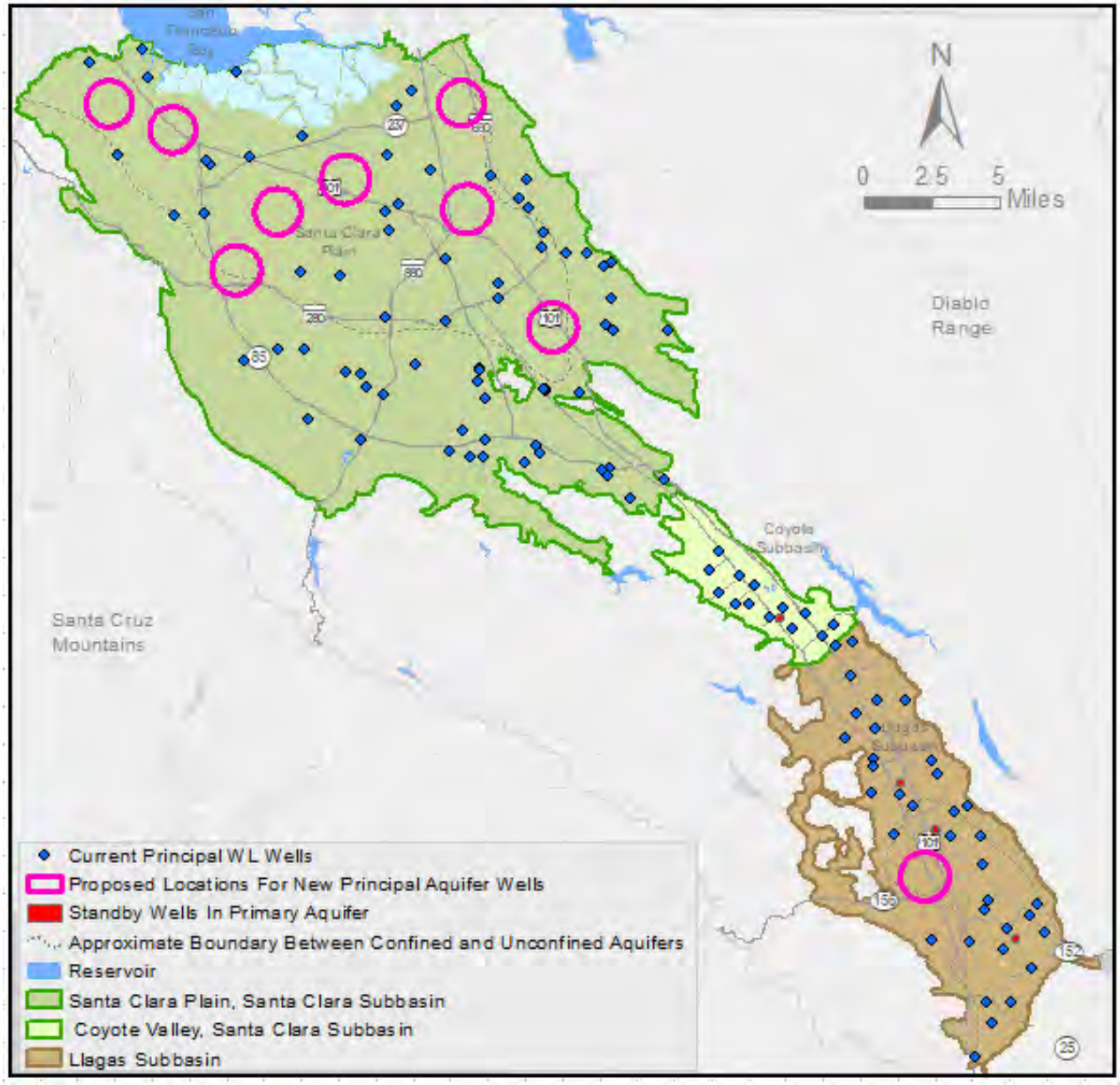
recommended locations where additional water level monitoring data might improve model accuracy (Figure 4). These recommendations were based on groundwater modeling experience and professional judgement, rather than on a formal model sensitivity or other similar analysis. Figure 4 indicates that these areas with monitoring gaps are generally along the boundary of the Santa Clara and Llagas subbasins. In the Santa Clara Plain, the areas with monitoring gaps are along the eastern, northern, and western boundaries (Figure 4). In Coyote Valley, the areas with monitoring gaps are in the northwestern area near Laguna Seca and along the southwestern and southeastern boundaries, particularly in the areas immediately downstream of Anderson Reservoir (Figure 4). In the Llagas Subbasin, the areas with monitoring gaps are along the western boundary downstream of Uvas and Chesbro Reservoirs, along the northern boundary, and near Morgan Hill (Figure 4). Many of these recommendations by the groundwater modelers are in areas of relatively shallow depth to water or the shallow aquifer zone.

Figure 4. Areas Identified by Valley Water Groundwater Modelers as Needing Additional Monitoring Wells



Based on a combination of the Thiessen polygon analysis (Figure 1) and areas identified by GWMU groundwater modeling staff (Figure 4), areas in the principal aquifer that have gaps and may be appropriate for additional principal aquifer monitoring wells are shown in Figure 5 as proposed locations for new wells. The majority of these proposed locations are in the Santa Clara Plain and one is in the Llagas Subbasin. Figure 5 also shows the location of four standby wells that are not currently used in the water level monitoring program but are available to be activated into the program. Unfortunately, none of the standby wells are in existing spatial gaps (Figure 5).

Figure 5. Currently Monitored Wells and Proposed Locations for Wells in the Principal Aquifer

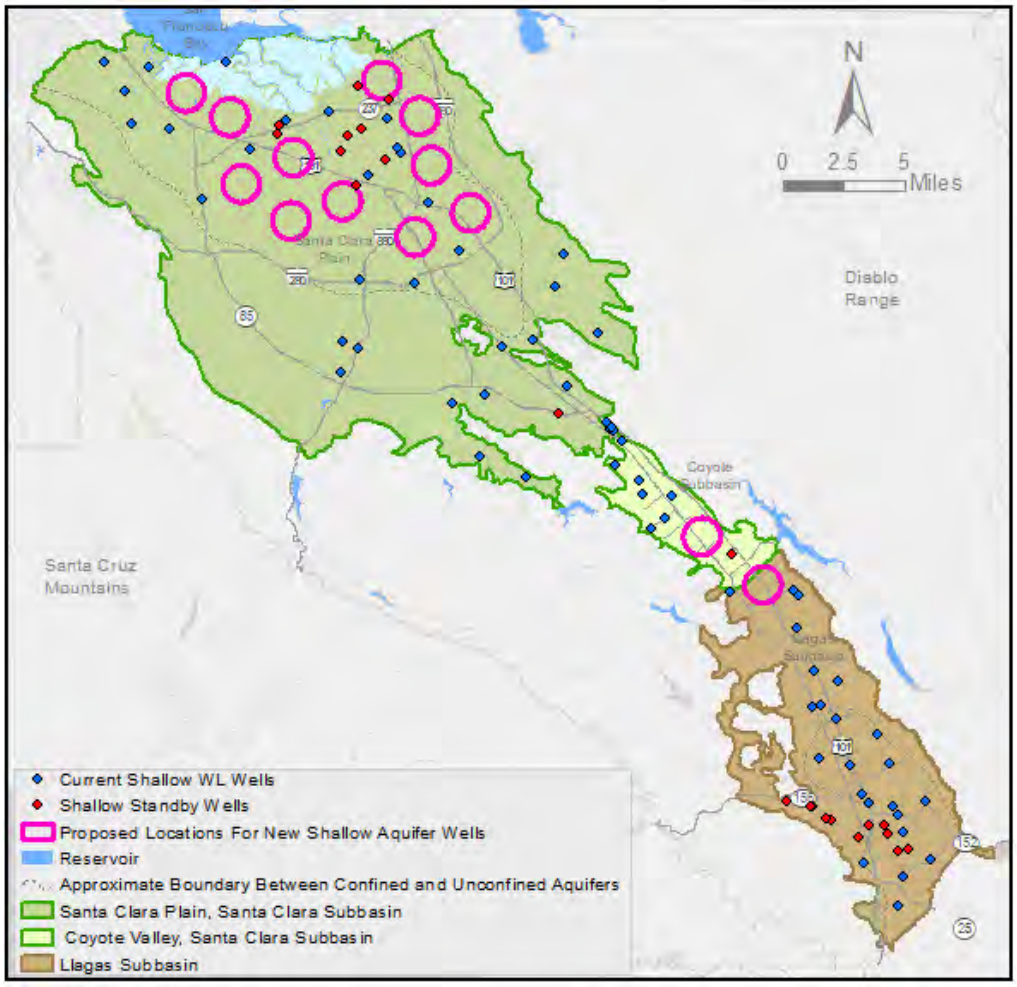


3.3.2. Shallow Aquifer Monitoring Wells

Similar to the principal aquifer gap analysis, the shallow aquifer wells (<150 ft bls) were analyzed using a combination of results from the Thiessen polygon analysis and professional judgement from Valley Water staff. The nine areas in the shallow aquifer that have gaps and may be appropriate for additional monitoring wells are generally located in the Santa Clara Plain overlying the confined aquifer zone (Figure 6). Several of these gaps along the Bay would be appropriate for additional wells to help monitor water levels and groundwater quality to support seawater intrusion (SWI) monitoring.

Figure 6 also shows the location of 18 standby wells that are not currently used in the water level monitoring program but are available to be activated into the program. Several of these standby wells are in existing spatial gaps where proposed wells are recommended, such as in the Santa Clara Plain near the Bay (Figure 5). There are several standby wells in Coyote Valley and Llagas Subbasin that should be evaluated further to determine if they should be added to the water level monitoring program, especially in the areas downstream of Anderson Reservoir in Coyote Valley and downstream of Uvas and Chesbro Reservoirs in the Llagas Subbasin.

Figure 6. Currently Monitored Wells and Proposed Locations for Wells in the Shallow Aquifer



3.3.3. Very Shallow Aquifer Monitoring Wells

The very shallow aquifer wells (<50 ft bls) were also analyzed using a combination of results from the Thiessen polygon analysis and professional judgement from Valley Water staff. The areas in the very shallow aquifer that have gaps and may be appropriate for additional monitoring wells are located in each subbasin (Figure 7). Many of these areas are part of Valley Water's managed recharge program and provide instream recharge (Figure 8). Additional monitoring wells in the very shallow aquifer along creeks overlying the confined area of the Santa Clara Plain and near the bayfront would be particularly beneficial to help better understand mechanisms of seawater intrusion, including leakance of saltwater beneath tidal stream flow along Coyote Creek and Guadalupe River. Appendix H of the 2021 GWMP summarizes the seawater intrusion mechanisms and supports the need for additional monitoring wells near the Bay and along tidally influenced streams that may contribute to seawater intrusion. There are at least five standby wells in the very shallow aquifer that are located near the Bay and adjacent to Coyote Creek and Guadalupe River. These standby wells should be further evaluated and if appropriate, added to the water level monitoring and seawater intrusion monitoring networks.

Figure 7. Currently Monitored Wells and Proposed Locations for Wells in the Very Shallow Aquifer

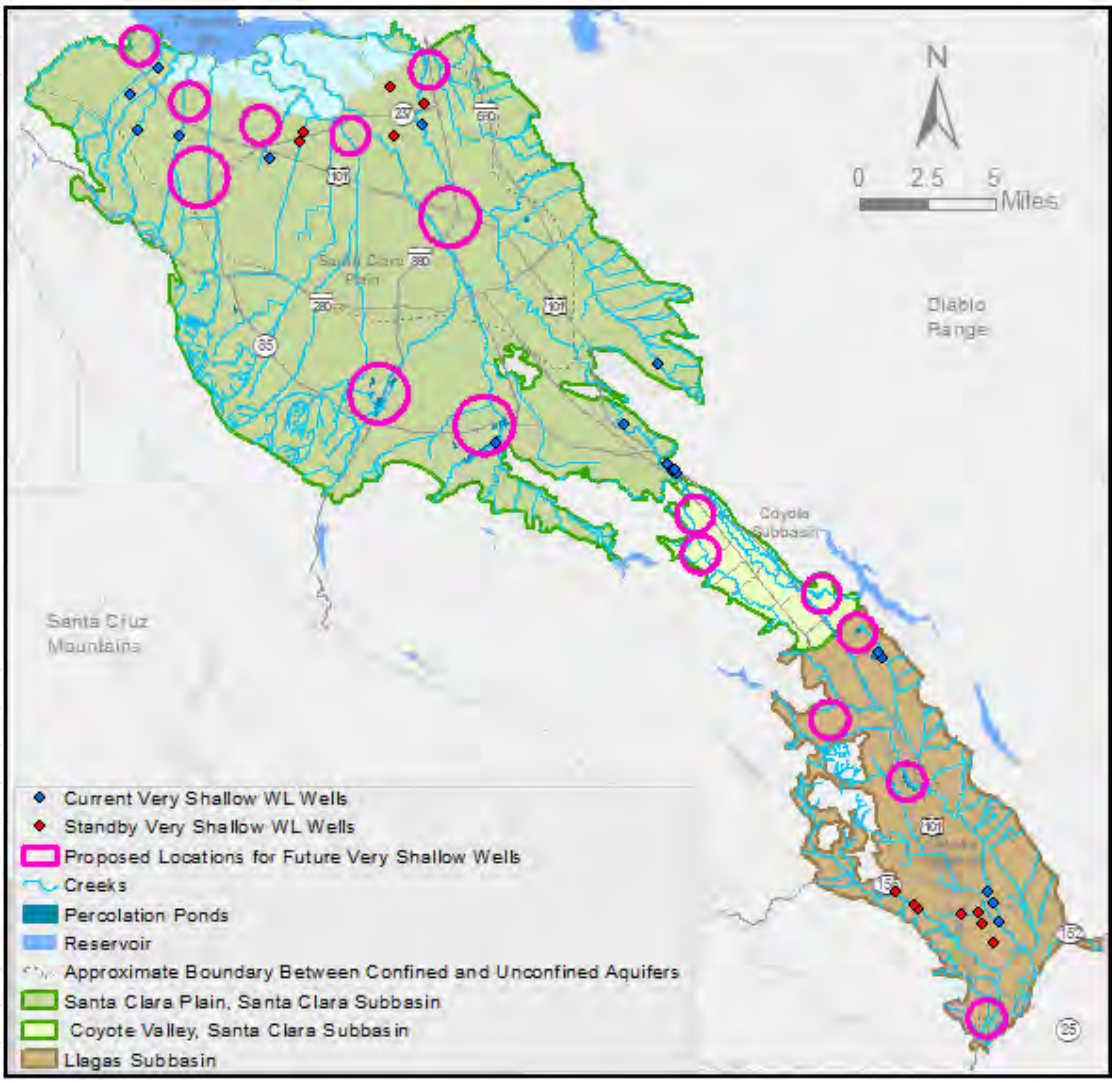


Figure 8a. Managed Recharge Facilities in the Santa Clara Subbasin (from Figure 4-3 and 4-4 of the 2021 GWMP).

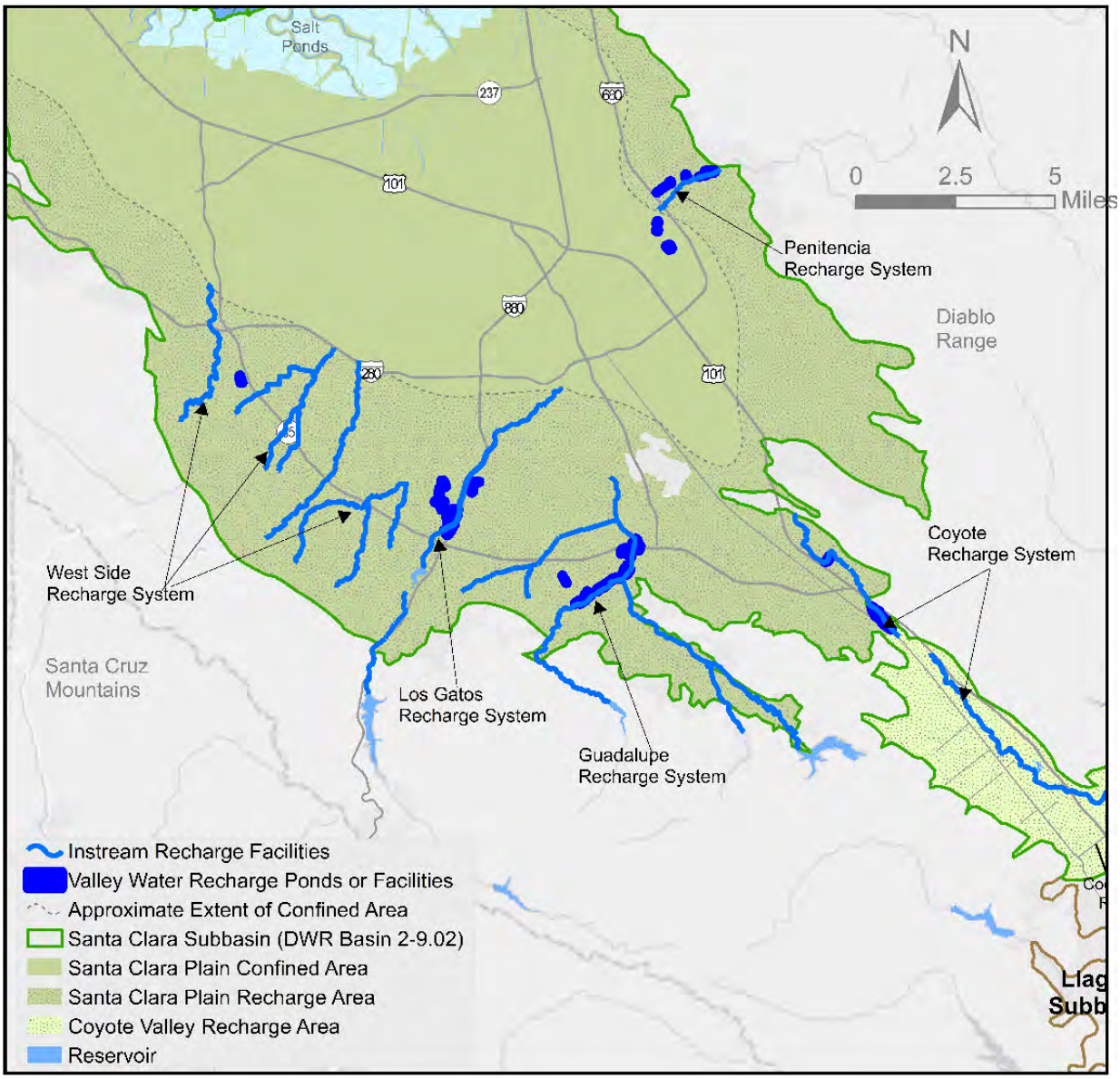


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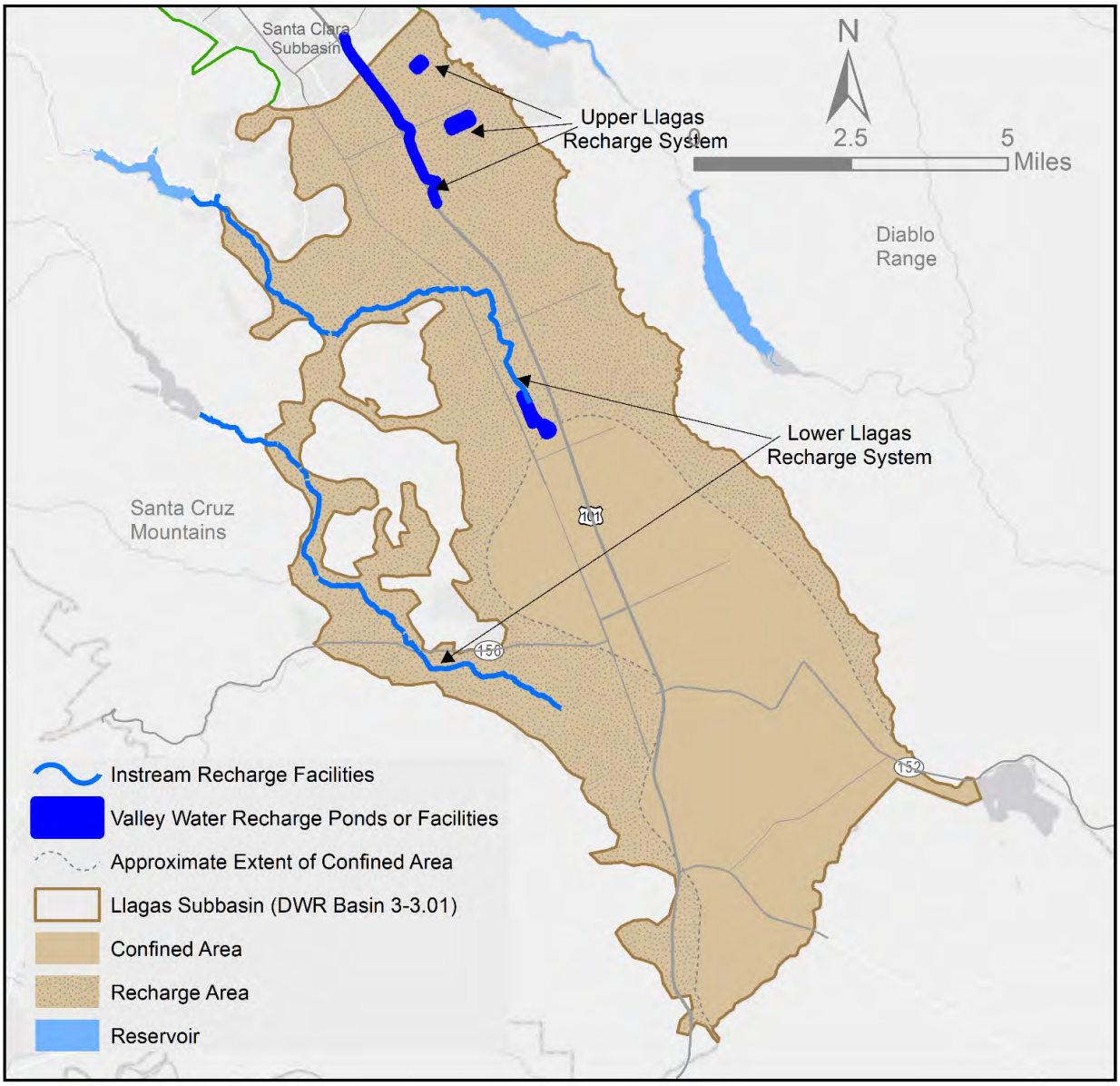
Figure 8b. Managed Recharge Facilities in the Llagas Subbasin (from Figure 4-3 and 4-4 of the 2021 GWMP).



3.4. Methods to Fills Gaps in the Water Level Monitoring Network

There are five general methods to fill in the gaps in the existing water level monitoring network: (i) activate Valley Water wells currently on standby, (ii) install new wells, (iii) acquire existing wells, (iv) partner with entities that regularly monitor their own wells, and (v) gain access to and monitor existing wells owned by others. Each method has advantages and disadvantages that can apply generally or be site-specific.

The quickest, easiest, and most cost-effective method to fill network gaps is to activate existing wells in the gap areas that are currently on standby. Many of these wells were installed for projects that are now completed but the wells have not been destroyed. As described in previous sections, activating

the standby wells in the shallow and very shallow aquifer zones may help fill existing gaps. However, there are no standby wells that would fill gaps in the principal aquifer zone. Well construction information may not be available for all standby wells.

The second method to fill the gaps is to install new monitoring wells that are located and owned by Valley Water. Installing new monitoring wells ensures that the wells are in the most favorable location with access to the well, screened at the appropriate depth, and that well construction information is known. However, installing new wells is more expensive and time consuming than activating standby wells.

The third method is opportunistic and involves acquiring existing wells. Acquiring existing wells enables easy access by Valley Water staff, but existing wells may not be in the best location or screened at the appropriate depth to fill existing gaps in the monitoring network. Additionally, some existing wells may not have well construction information and the well may be in poor condition and need rehabilitation.

The fourth method to fill network gaps is to partner with an entity, such as a water retailer that regularly collects water levels and ask them to share the data with Valley Water. This method is cost-effective in that Valley Water doesn't have to spend the time or money installing new wells. The disadvantages are similar to other methods because the existing well may not be in the ideal location or screened at the correct depth to adequately fill the monitoring gap. An additional disadvantage is that Valley Water is reliant on the partnering agency to collect and share the data. There have been instances where this partnership arrangement has led to lags in data sharing or gaps in data collection that were outside Valley Water's control. Additionally, many of the wells owned by retailers are high-capacity supply wells that are frequently in use. Therefore, water level readings from supply wells can frequently be pumping rather than static water level readings. Static water levels are better in terms of understanding general groundwater conditions.

The final method involves Valley Water gaining accessing to wells owned by others. The advantages and disadvantages of this method are similar to the fourth method. An advantage of this method is that Valley Water has well access and is not reliant on another agency to collect and share the data.

3.5. Recommendations for the Water Level Monitoring Network

Based on the gap analysis and available methods to fill those gaps, the following recommendations are outlined for each of the three aquifer zones: principal, shallow, and very shallow. The following list is prioritized based on coincident gaps located in multiple aquifer zones. For each of the following gaps, a similar process is recommended of first evaluating standby wells, then existing wells, and finally installing new monitoring wells, as needed. During the gap analysis, redundant water level wells were also evaluated, and it was determined that any redundant water level wells will remain in the network. The time and resources spent measuring a few extra water levels is minimal and these wells, with their continuous water level records, provide insurance against the loss of nearby wells. Additionally, a well density evaluation is recommended during the next gap analysis of the water level monitoring network to help support results from the Theissen polygon analysis.

3.5.1. Principal Aquifer

A priority is to fill the gaps in the northeastern corner of the Santa Clara Plain within the City of Milpitas and adjacent to the boundary between the Santa Clara Subbasin and the neighboring Niles Cone

Subbasin (see gaps identified as 1 in Figure 9). These gaps were identified in both the gap analysis (Figure 5) and recommended by the modelers (Figure 4). Water level data from these gaps would help to better quantify the hydraulic gradient between the two adjacent subbasins and between saltwater from the Bay and freshwater from the principal aquifer. There are no standby wells in this gap. Valley Water should search for any existing wells that could be either monitored by Valley Water or a partnering agency. If no suitable wells exist, new monitoring wells are recommended to be installed in the principal aquifer. As discussed in the next section, the shallow aquifer also has a gap in this same area. Therefore, installing nested piezometers that are screened in the principal, shallow, and very shallow aquifer zones is recommended.

A second priority set of gaps to fill are those two located in the central part of the northern Santa Clara Plain, overlying Highway 101 and the immediate southwest of Highway 101 (see gaps identified as 2 in Figure 9). These two gaps are a priority because they are coincident with gaps in the shallow (Figure 6) and very shallow aquifer zones (Figure 7). This location straddles the maximum known extent of seawater intrusion in the 1960s and is near the 2019 chloride 100 mg/L isocontour line (Figure 2-23 in the 2021 GWMP). These gaps could be filled with the installation of a set of new vertically nested monitoring wells that are screened in the principal, shallow, and very shallow aquifer zones.

A third priority set of gaps to fill are those in the northwestern corner of the Santa Clara Subbasin within the cities of Palo Alto and Mountain View (see gaps identified as 3 in Figure 9), which were identified in the gap analysis (Figure 5) and near gaps identified by the modelers (Figure 4). Filling these gaps will help quantify the hydraulic gradient between the Santa Clara Subbasin and the neighboring San Mateo Plain Subbasin. There are no standby wells in these gaps. Valley Water should search for any existing wells that could be either monitored by Valley Water or a partnering agency. If no suitable wells exist, a new monitoring well in the principal aquifer is recommended.

The remaining three gaps in the Santa Clara Plain and the one gap in the Llagas Subbasin (see gaps identified as 4 in Figure 9) could be filled if existing wells are available. If no suitable existing wells exist, installing new monitoring wells in the principal aquifer to fill these gaps is recommended, as resources become available.

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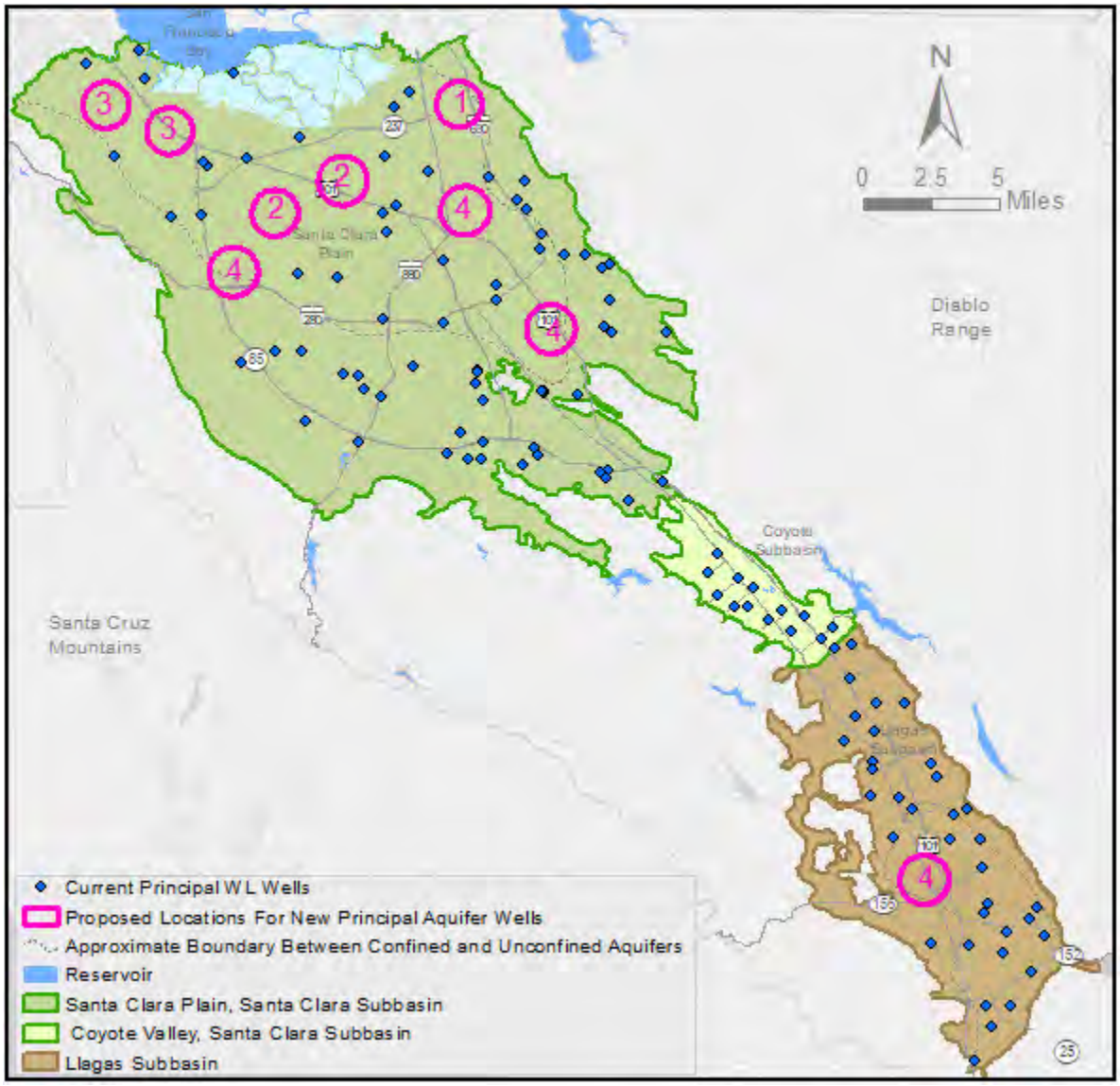
Figure 9. Recommended Priorities for Filling Monitoring Gaps in the Principal Aquifer.



3.5.2. Shallow Aquifer

A priority is to fill the gaps in the northeastern corner of the Santa Clara Plain within the City of Milpitas and adjacent to the boundary between the Santa Clara Subbasin and the neighboring Niles Cone Subbasin (see gaps identified as 1 in Figure 10). These gaps were identified in both the gap analysis (Figure 5) and recommended by the modelers (Figure 4). Water level data from these gaps would help to better quantify the hydraulic gradient between the two adjacent subbasins and between saltwater from the Bay and freshwater from the principal aquifer. There are no standby wells in this gap. Therefore, Valley Water should search for any existing wells that could be either monitored by Valley Water or a partnering agency. If no suitable wells exist, installing a new monitoring well in the principal aquifer is recommended. As discussed in the previous section, the principal aquifer also has a gap in this same area. Therefore, installing nested piezometers that are screened in the principal, shallow, and very shallow aquifer zones is recommended.

A second priority set of gaps to fill are those two located in the central part of the northern Santa Clara Plain, overlying Highway 101 and the immediate southwest of Highway 101 (see gaps identified as 2 in Figure 10). These two gaps are a priority because that are coincident with gaps in the principal (Figure 5) and very shallow aquifer zones (Figure 7). This location straddles the maximum known extent of seawater intrusion in the 1960s and is near the 2019 100 mg/L chloride isocontour line (Figure 2-23 in the 2021 GWMP). One of these gaps could be filled by activating a standby well, but additional evaluation of the well needed (Figure 10). The second gap could be filled with the installation of a set of new vertically nested monitoring wells that are screened in the principal, shallow, and very shallow aquifer zones.

A third priority gap is located in the northwestern corner of the Santa Clara Subbasin near the salt ponds (see gaps identified as 3 in Figure 10), which was identified in the gap analysis (Figure 5) and near gaps identified by the modelers (Figure 4). Filling this gap will help to quantify the chloride concentrations within the 100 mg/L chloride isocontour line, which is one of the outcome measures in the 2021 GWMP. This gap is located near priority gap #3 in the principal aquifer (Figure 9) and thus could be combined as part of a vertically nested monitoring well in both aquifer zones. Another pair of wells in South Santa Clara County falls in this third priority. Adding these two wells will help to better understand the groundwater flow on either side of the groundwater divide between the Coyote and Llagas subbasins.

A fourth priority set of gaps are located along the margin of the maximum known extent of seawater intrusion in the 1960s and is near the 2019 100 mg/L chloride isocontour line (Figure 2-23 in the 2021 GWMP). Installing monitoring wells in these gaps would help to better quantify the 100 mg/L chloride isocontour line and monitor the extent of seawater intrusion.

The remaining gap in the Santa Clara Plain (see gaps identified as 5 in Figure 10) could be filled if an existing well is available. If no suitable existing wells exist, installing a new monitoring well in the shallow aquifer to fill the gap is recommended, as resources become available.

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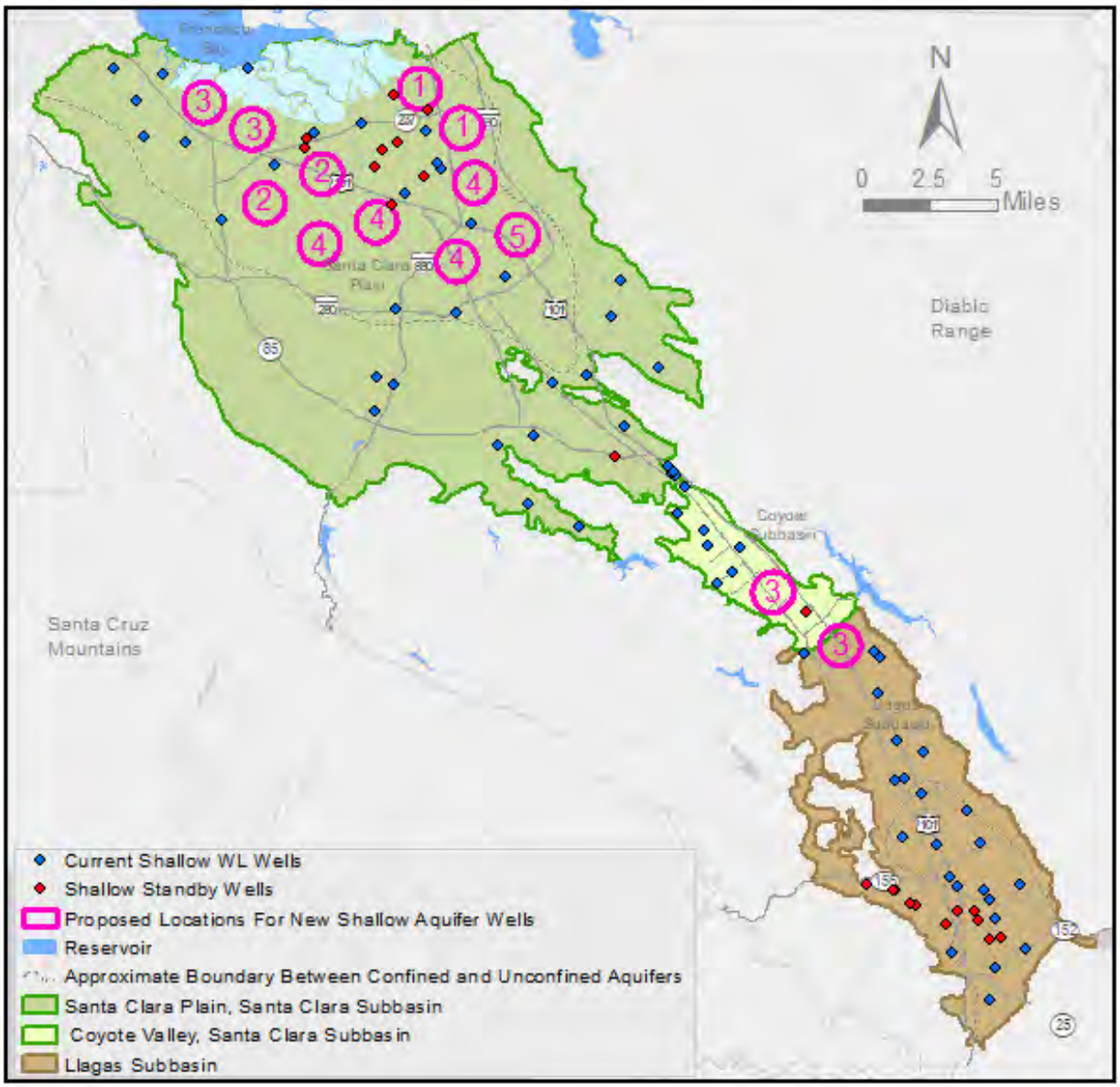
Figure 10. Recommended Priorities for Filling Monitoring Gaps in the Shallow Aquifer.

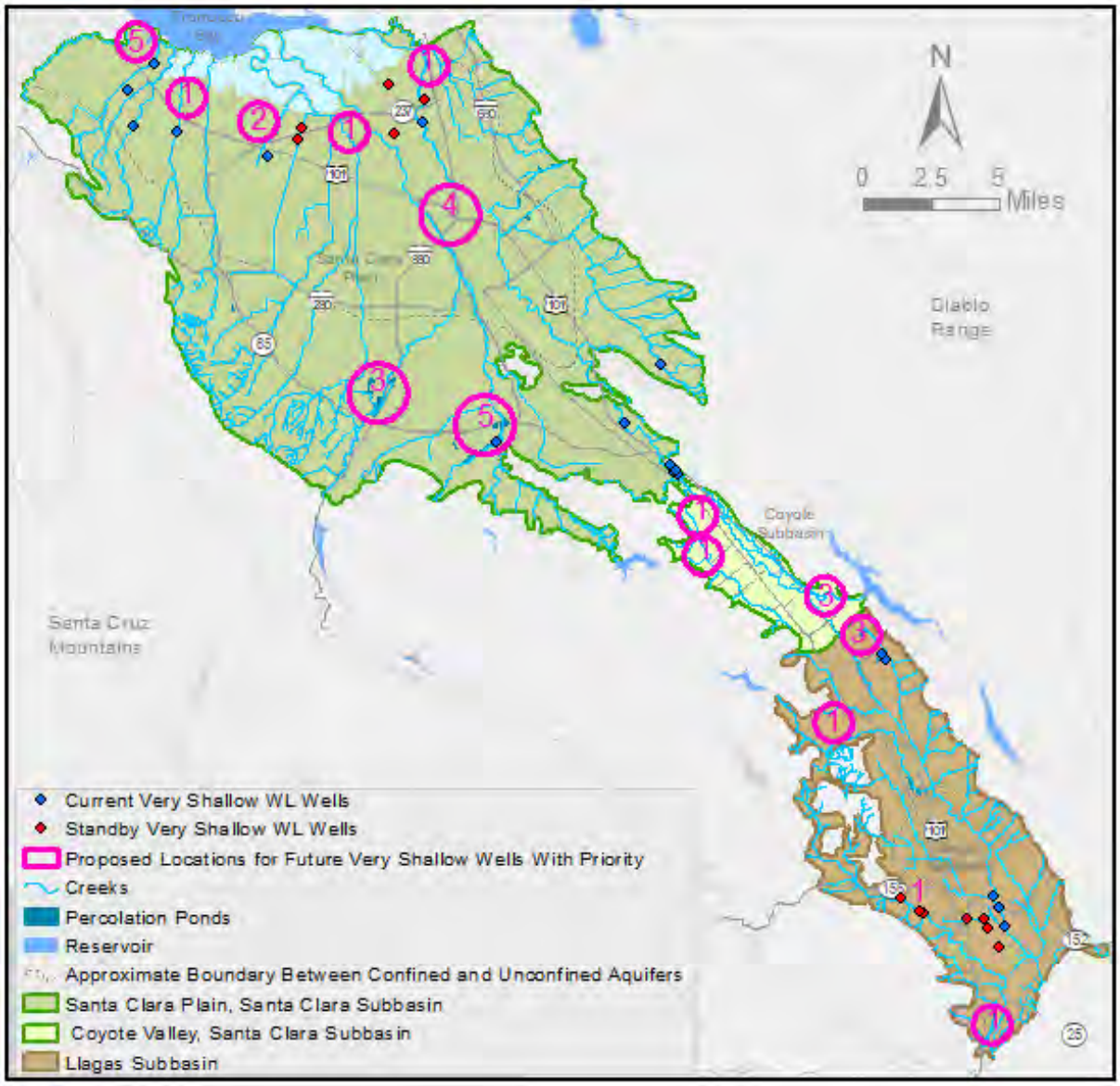


3.5.3. Very Shallow Aquifer

A priority is to fill the gaps identified as 1 in the very shallow aquifer zone of the Santa Clara and Llagas subbasins (Figure 11). The gaps identified as 1 in the Santa Clara Plain would provide data to better quantify seawater intrusion mechanisms that influence the 100 mg/L chloride isocontour line. The gaps identified as 1 in the Coyote Valley and Llagas Subbasin would help to quantify the groundwater/surface-water interaction in the Laguna Seca area, downstream of Uvas Reservoir and at the Pajaro River, which are identified as recommendations in the groundwater dependent ecosystem (GDE) analysis (Appendix G) of the 2021 GWMP. Some of these gaps are prioritized first because they are near standby wells that could be activated. Additional evaluation of these standby wells is needed to ensure they are suitable for water level monitoring.

A second priority gap to fill is located in the central part of the northern Santa Clara Plain, overlying Highway 101 and the immediate southwest of Highway 101 (see gaps identified as 2 in Figure 11). This gap is a priority because it is coincident with gaps in the principal (Figure 9) and very shallow aquifer zones (Figure 10). This location straddles the maximum known extent of seawater intrusion in the 1960s and is near the 2019 100 mg/L chloride isocontour line (Figure 2-23 in the 2021 GWMP). The gap could be filled with the installation of a set of new vertically nested monitoring wells that are screened in the principal, shallow, and very shallow aquifer zones. In the Llagas Subbasin, a second priority gap to fill is downstream of Chesbro Reservoir, which was identified as a recommendation in the GDE analysis (Appendix G) of the 2021 GWMP to better quantify groundwater/surface-water interactions. Based on the gap analysis, new monitoring wells would likely be needed to fill this gap downstream of Chesbro Reservoir.

Figure 11. Recommended Priorities for Filling Monitoring Gaps in the **Very** Shallow Aquifer.



A third priority gap is located in the northwestern corner of the Santa Clara Subbasin near the salt ponds (see gaps identified as 3 in Figure 11), which was identified in the gap analysis (Figure 7) and near

gaps identified by the modelers (Figure 4). Filling this gap will help to quantify seawater intrusion mechanisms and the chloride concentrations within the 100 mg/L chloride isocontour line, which is one of the outcome measures in the 2021 GWMP. This gap is located near priority gap #3 in the principal (Figure 9) and shallow (Figure 10) zones and thus could be combined as part of a vertically nested monitoring well. An additional third priority gap is located in the southwest corner of the Santa Clara Plain. This area is a possible site for recharge of recycled water and as such detailed monitoring of the effects of recycled water on the shallow aquifer and GDEs is necessary.

A fourth priority gap is located near the intersection of Highways 101 and 880 (see gap identified as 4 in Figure 11). Installing a monitoring well here would help to characterize shallow groundwater conditions and occurrence of emergent groundwater. Further evaluation is needed to identify if existing wells are available for water level monitoring or if installation of a new monitoring well is appropriate.

The remaining gap in the Santa Clara Plain (see gaps identified as 5 in Figure 11) could be filled if an existing well is available. If no suitable existing wells exist, installing a new monitoring well in the very shallow aquifer to fill the gaps is recommended, as resources become available.

4. Land Subsidence Monitoring

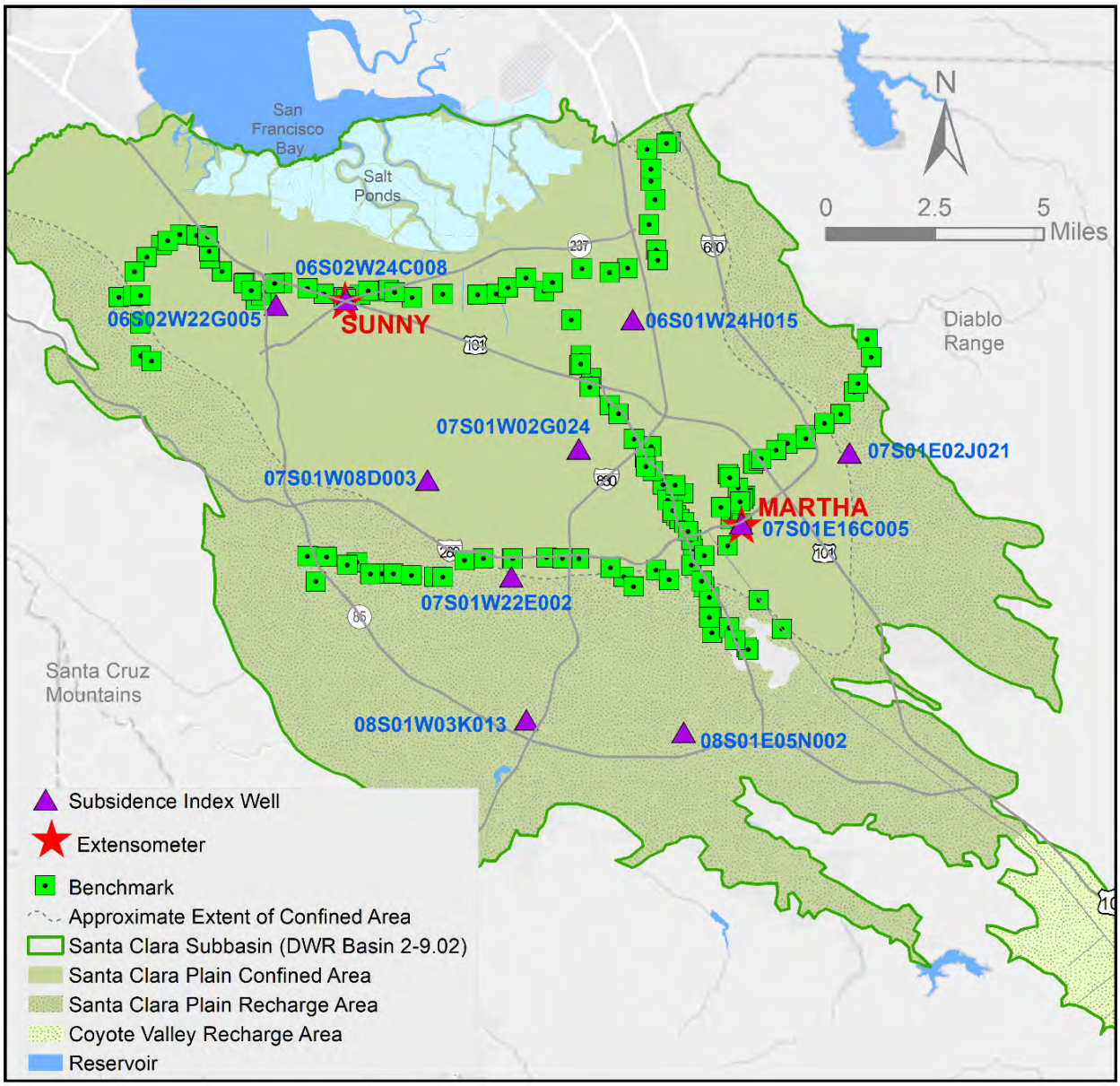
Inelastic and permanent land subsidence (subsidence) has been recognized in parts of California, including the Santa Clara Subbasin for many decades. In fact, the northern Santa Clara Subbasin was one of the first areas in the United States where permanent land subsidence due to groundwater withdrawals was recognized (Poland and Ireland, 1988). Under SGMA, subsidence is one of the six sustainability indicators, and corresponding regulations (*23 CCR §354.34(c)(5)*) state that GSAs shall "Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method."[2] DWR (2016) guidance states that "Observation of land subsidence sustainability indicators can utilize numerous techniques, including levelling surveying tied to known benchmarks, installing, and tracking changes in borehole extensometers, monitoring continuous global position system (CGPS) locations, or analyzing interferometric synthetic aperture radar (InSAR) data." The DWR (2016) guidance further explains that groundwater levels can be used as a surrogate to indicate the conditions of subsidence, or lack thereof. Furthermore, each method to monitor subsidence conditions uses different measuring points and techniques and must be tailored to the specific needs of the GSA and geologic conditions. DWR (2016) explains that where subsidence conditions are occurring or believed to occur, a specific monitoring network should be established to observe the sustainability indicator such that the sustainability goal can be met.

Because subsidence has occurred historically (prior to the 1970s) in the northern portion of the Santa Clara Subbasin, for many decades Valley Water has maintained a comprehensive subsidence monitoring network to determine if subsidence is occurring or threatening to exceed the outcome measure thresholds for subsidence. Valley Water's subsidence monitoring network is located entirely within the Santa Clara Plain management area of the Santa Clara Subbasin (Figure 12). Due to difference in the hydrogeologic setting, subsidence has not been observed in either the Coyote Valley management area of the Santa Clara Subbasin or in the Llagas Subbasin. The subsidence monitoring network has three distinct but complementary components: (i) water level monitoring at 10 subsidence index wells, (ii) annual land surveys at benchmark along three cross-valley circuits, and (iii) two long-term extensometers

[2] Alternatives to GSPs, such as the 2021 GWMP, are not subject to the specific requirements for GSPs, but must demonstrate functional equivalency.

(Figure 12). This 2021 GWMP adds Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR[3] as another complementary component to the subsidence monitoring network.

Figure 12. Valley Water Subsidence Monitoring Network.



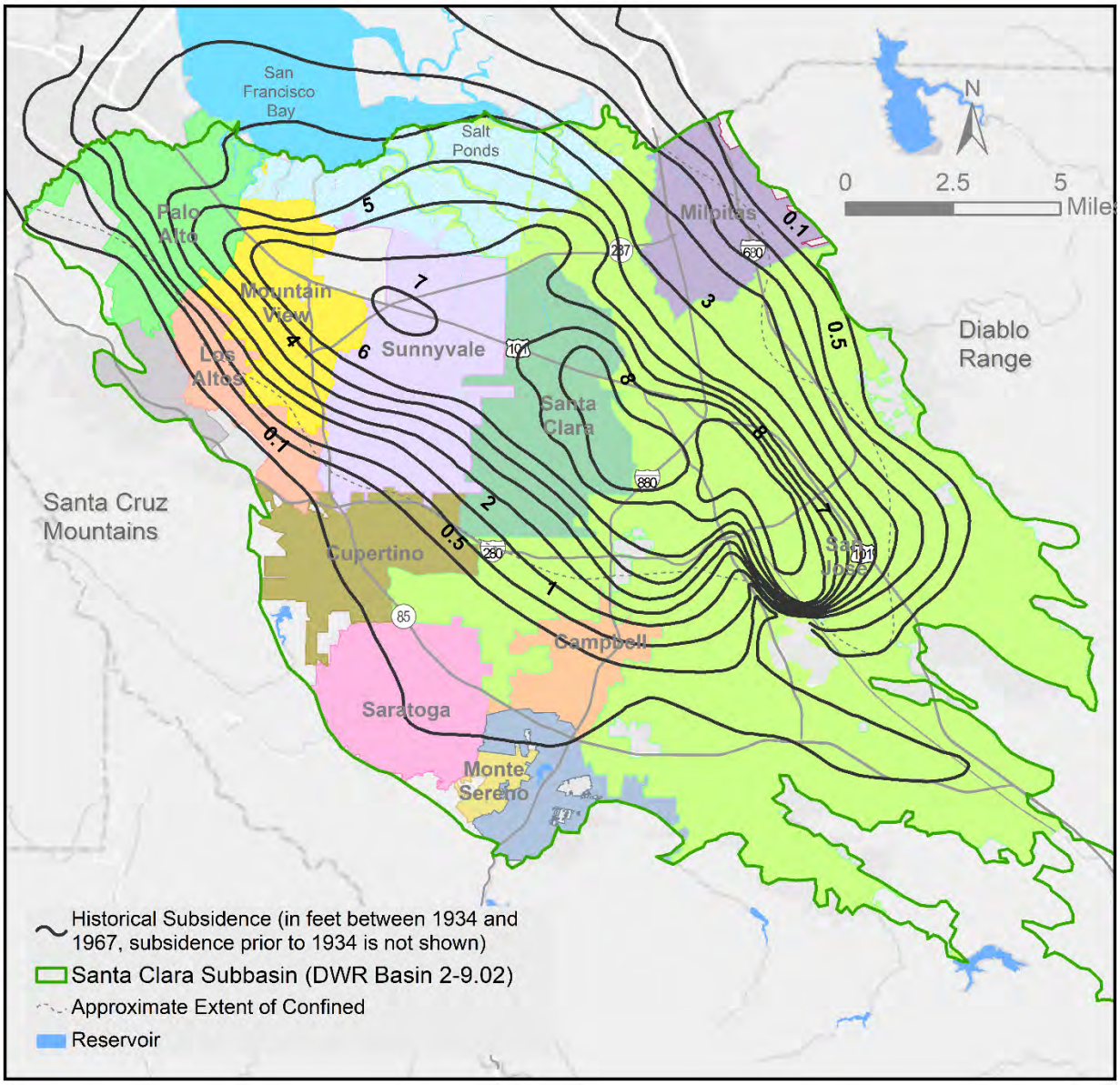
The overall methods and location of the complementary components of the subsidence network were designed to extend across the majority of the Santa Clara Plain that experienced historical subsidence (Figure 13). Due to historical long-term overdraft, fluid pressure in the aquifer was reduced, which resulted in the compression of fine-grained materials and subsidence. While the subsidence was spatially extensive across the Santa Clara Plain, the greatest subsidence was observed along the north-

[3] https://data.cnra.ca.gov/dataset/tre-altamira-insar-subsidence

south axis of the valley, particularly in the cities of San Jose, Sunnyvale, and Santa Clara that experienced more than 7 feet of subsidence (Figure 13).

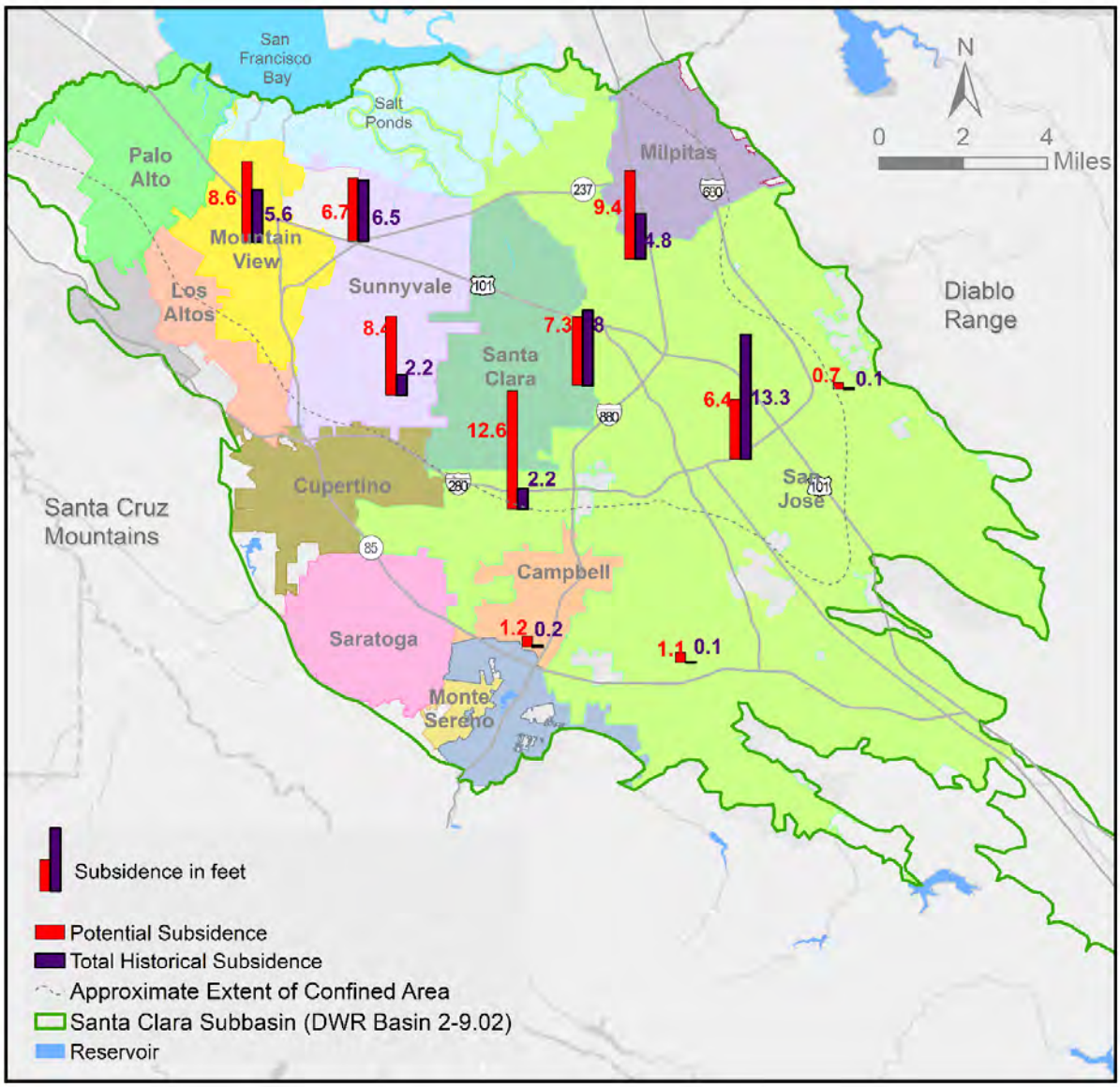
Because of Valley Water's expanded conjunctive management programs that allowed artesian conditions to recover substantially, inelastic subsidence was essentially halted by about 1970 (GWMP, 2016). Valley Water established an acceptable subsidence rate of no more than 0.01 feet per year on average, which was endorsed by the Water Retailer Groundwater Subcommittee (GWMP, 2016). This acceptable subsidence rate has since been evaluated annually and used to inform groundwater management practices and programs.

Figure 13. Historical Subsidence in the Santa Clara Plain (1934 – 1967) (Figure 2-12 from the 2021 GWMP).



In addition to establishing the acceptable subsidence rate (0.01 ft/yr), Valley Water has also evaluated the remaining potential for subsidence under scenarios of prolonged overdraft (Figure 14). Results of this analysis was used to establish water level thresholds at 10 subsidence index wells (Figure 12), which have since been used as the subsidence Outcome Measure (OM) in the GWMP. Therefore, monitoring data from the subsidence network is evaluated annually to ensure that Valley Water's management practices are meeting the subsidence OM. The following sections describe each of the three complementary components of the subsidence network, including the status, any identified gaps or redundancies, and associated recommendations.

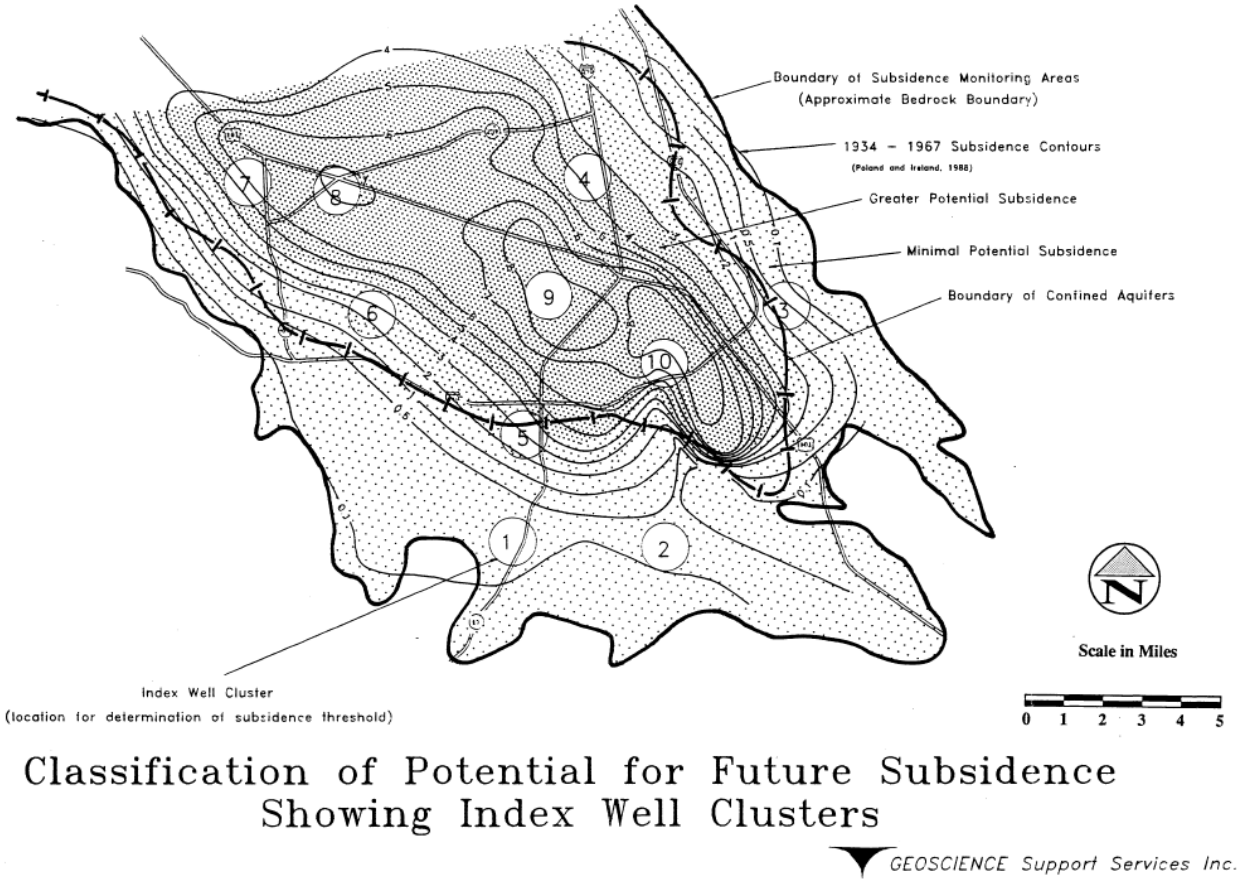
Figure 14. Historical and Potential Subsidence in the Santa Clara Plain (Figure 2-13 from the 2021 GWMP.



4.1. Water Level Monitoring at 10 Subsidence Index Wells

The location of the 10 subsidence index wells (Figure 12) is coincident with the location of the study sites used to estimate the remaining potential for subsidence under scenarios of prolonged overdraft (Figure 14). These 10 locations were selected to help estimate the subsidence threshold using the PRESS model (Geosciences Support Services, 1991). PRESS stands for the Predictions Relating Effective Stress and Subsidence model, which is a numerical model that is based on sediment consolidation theory and can be used to simulate and predict subsidence caused by groundwater level decline. Fifty percent of the subsidence index wells were selected in the areas of the Santa Clara Plain that have a relatively greater potential for future subsidence, including index wells 4, 7, 8, 9, and 10 (Figures 14 and 15). Thirty percent of the index wells were selected in areas having minimal potential for future subsidence, including wells 1, 2, and 3 (Figures 14 and 15). The remaining 20% are located in the transition between the two zones and include wells 5 and 6 (Figures 14 and 15). The 10 index wells have a good spatial coverage across the Santa Clara Plain, including the gradient from areas of relatively minimal to greater potential for future subsidence (Figures 14 and 15).

Figure 15. Classification of the 10 Subsidence Index Wells from the 1991 Geosciences Report



4.2. Annual Land Surveys at Benchmarks

Periodic level surveys of land elevation have been conducted in the Santa Clara Subbasin to gauge land subsidence induced by groundwater overdraft since 1934.[4] Currently, Valley Water conducts annual surveys each fall to determine the elevations of about 140 survey benchmarks along three Cross Valley Level Circuits (CVLCs): two east-west circuits and one north-south circuit in the Santa Clara Plain (Figure 12). The locations of the three CVLCs were selected to cover areas of the Santa Clara Plain that had the greatest historical subsidence, including along the north-south axis of the valley and the east-west circuit closest to the Bay (Figure 13) and the greatest potential for future subsidence (Figures 14 and 15). The east-west CVLC furthest away from the Bay covers a larger gradient of historical subsidence and provides a context for comparison for the CVLC closest to the Bay. Changes in benchmark elevations are tracked year to year and are evaluated with data collected at extensometers and subsidence index wells. The results of the land surveys provide an annual snapshot of the spatial land subsidence conditions across the Santa Clara Plain and are reported in Valley Water Annual Groundwater Report.

No inelastic (permanent) subsidence has been observed in the Santa Clara Plain since the early 1970s. However, there has been elastic (temporary) subsidence and uplift in the Santa Clara Plain, as shown by the annual land surveys. During periods of groundwater level decline, the land surveys typically observe elastic subsidence, and during periods of groundwater level increase, the land surveys typically observe elastic uplift in the land surface. The results of the land surveys typically support compaction and uplift readings from the two extensometers, as described next. A benefit of the land surveys is they provide a greater spatial coverage than the two extensometers. However, to provide a greater spatial coverage than the annual land surveys, the 2021 GWMP includes InSAR data for the entire Santa Clara Plain from 2015 to 2019 (Figure 2-14 from the 2021 GWMP). The InSAR data indicates uplift of ground surface between that is consistent with increasing groundwater levels from 2015 to 2019.

4.3. Extensometers

Valley Water maintains and collects data from two extensometers installed by the USGS in 1960 to monitor the magnitude and rate of subsidence in the Santa Clara Plain. The two extensometer sites are continuously monitored; one in Sunnyvale near Moffett Field ("Sunny") and the other near downtown San Jose at San Jose Water Company's 12th Street well field ("Martha") (Figure 12). The locations of the extensometers coincide with areas of both the greatest historical subsidence (Figure 13) and greatest potential for future subsidence (Figures 14 and 15). The Martha extensometer is located near an area of maximum historical subsidence (>13 feet) and the Sunny extensometer is located near an area of over 7 feet of historical subsidence (Figure 13).

The Martha and Sunny extensometers measure vertical ground motion relative to points 1,000 feet deep using a pipe set beneath the water-bearing aquifers that have the potential to compress and cause subsidence. To measure the change in land surface elevation, it is assumed that the pipe is fixed at the bottom and that the sediment between the pipe bottom and the land surface is expanding or compressing. As compared to the land surveys and InSAR data, the extensometers provide local or point-scale measurements. However, the extensometers are designed to measure subsidence or uplift associated with changes in groundwater storage, whereas the land surveys and InSAR data could also

[4] Poland and Ireland, Land Subsidence in the Santa Clara Valley, California, as of 1982, 1988.

reflect changes in land surface associated with tectonic activity. Additional details about the extensometers instrumentation and data collection are in section 7.2.2 of the 2021 GWMP.

4.4. Recommendations

In general, the current subsidence monitoring network provides appropriate data to evaluate subsidence conditions and related outcome measures (see Chapter 5 of the 2021 GWMP). There are no apparent gaps or redundancies in the subsidence monitoring network. While some of Valley Water's other monitoring programs, such as the water level program, have developed as part of an adaptive and opportunistic data collection effort, the design and implementation of the subsidence monitoring network has been much more deliberate and targeted to the areas of the Santa Clara Subbasin with the greatest historical subsidence and potential for future subsidence. In additional to the excellent spatial coverage, the complementary components of the subsidence monitoring network ensure data collection over a range of temporal scales, from continuous monitoring of the extensometers to monthly monitoring of the index wells, and annual and longer monitoring from the land survey and InSAR data.

Due to the age of the extensometers, Valley Water should conduct a regular evaluation of the performance of the extensometers, particularly compared to the other independent data from land surveys and InSAR. Regular preventative maintenance on the extensometers is also required. During this next five-year update of the GWMP, Valley Water should conduct a critical evaluation of the extensometers and determine if replacement extensometers are needed and whether other technologies, such as InSAR, may be an appropriate replacement.

The subsidence thresholds at the 10 index wells were established by the 1991 Geosciences Services study. The groundwater levels in the Santa Clara Subbasin in 1991 were generally much lower than present-day conditions. Therefore, Valley Water should evaluate the subsidence thresholds at index wells under present-day groundwater conditions for continued protection against resuming inelastic (permanent) subsidence in the Santa Clara Subbasin. Additionally, Valley Water should evaluate the relationship between short-term declines in groundwater levels at index wells and the response between elastic (temporary) versus inelastic (permanent) subsidence.

5. Groundwater Quality Monitoring

Valley Water conducts the following groundwater quality monitoring programs: 1) regional groundwater quality, 2) recycled water, and 3) domestic well testing. The regional groundwater quality program incorporates general groundwater quality and seawater intrusion monitoring into one sampling event, which takes place annually during the fall. The regional groundwater quality program is discussed next in section 5.1, while the domestic well testing, recycled water, and seawater intrusion monitoring are discussed in sections 5.2, 5.3, and 5.4, respectively. This memo also briefly describes groundwater quality monitoring programs by other agencies in section 5.1.8.

5.1. Regional Groundwater Quality Monitoring Program

5.1.1. Background

The regional groundwater quality monitoring program began in the early 1980s consisting of 11 wells in the Santa Clara Plain and 18 wells in Coyote Valley and Llagas Subbasin. Intermittent monitoring of the general quality of groundwater and impacts of nitrate occurred from the early 1980s until about

2000. Beginning in 1997, further improvements were made to this monitoring program by adding 22 public water supply wells to better represent the Santa Clara Plain.

Volatile Organic Compounds (VOC) testing began in 1999 and sampling frequency increased from once every two years to annual. Currently, VOCs are sampled every three years. In addition, trace element sampling frequency increased from once every six years to annual. From 2002 to 2004, eight multi-well monitoring well sites and one single-well monitoring site were installed in the Santa Clara Plain in cooperation with United States Geological Survey (USGS). In 2006, Valley Water installed 11 monitoring wells to improve monitoring in the Coyote Valley and Llagas Subbasin under a grant agreement from DWR.

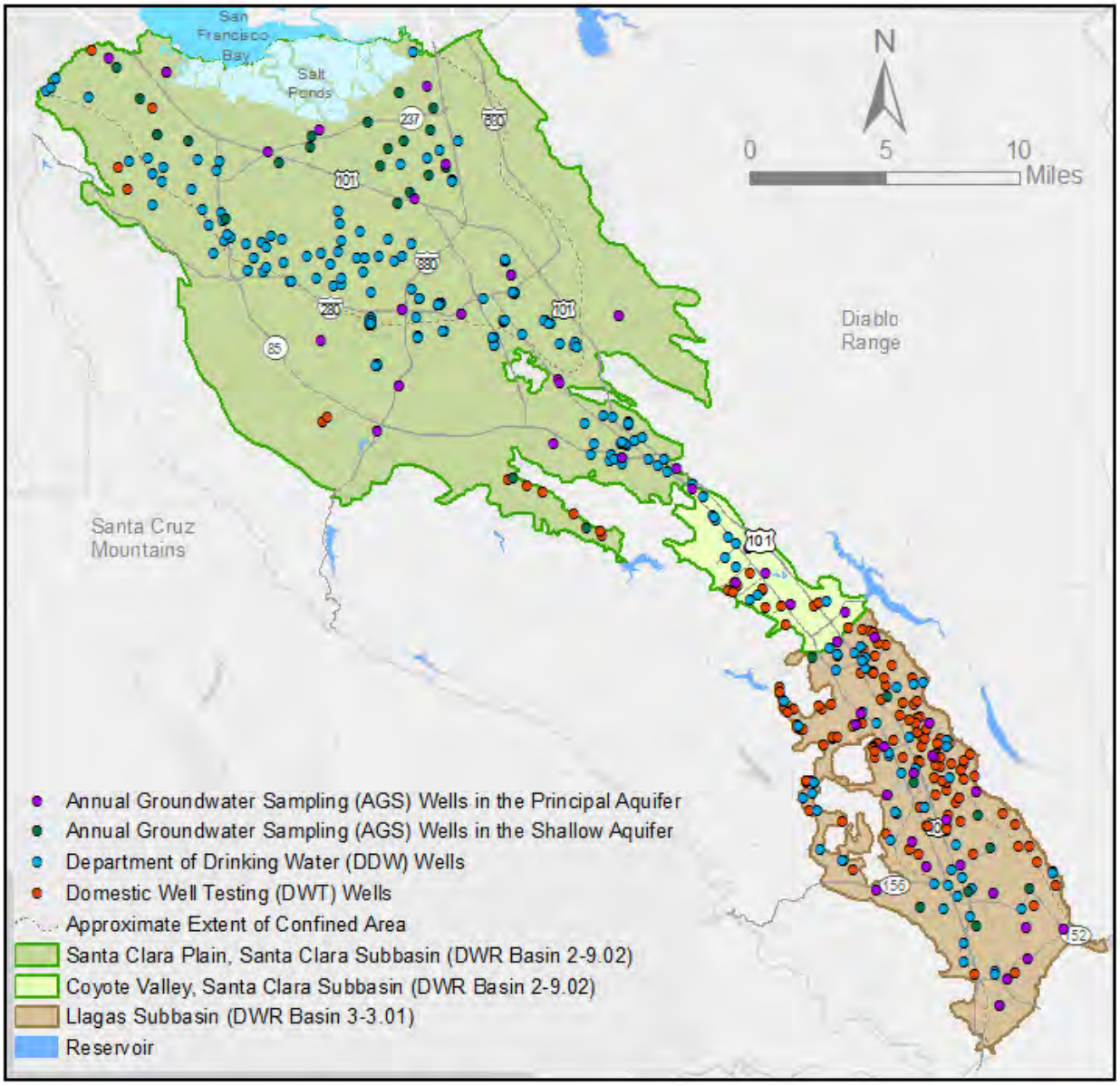
In May 2010, there were 111 individual wells, occupying 82 unique locations identified in the regional groundwater monitoring program, covering the Santa Clara Plain, Coyote Valley, and the Llagas Subbasin. To enhance the regional program, test results from many other wells supplied by the State were added to the groundwater quality dataset. Analyses included VOCs, major and minor ions, and trace elements.

5.1.2. Current Status

The regional groundwater quality monitoring program (commonly referred to as the "annual groundwater sampling" or AGS) is comprised of a variety of wells in both the shallow and principal aquifer zones. Well types in the program consist of monitoring, irrigation, public water supply, and domestic water supply wells. Some of the wells within the regional groundwater quality monitoring program are also used in other programs such as the recycled water and water level monitoring programs.

Valley Water uses data from the regional groundwater quality and domestic well testing (DWT) programs, along with public water supplier data downloaded from the California Department of Drinking Water (DDW) database to summarize and evaluate basin groundwater quality and analyze water quality trends. This annual analysis for basin groundwater quality and trends is reported in Valley Water's Annual Groundwater Report (AGR). Figure 16 shows the locations of the wells used in this annual analysis and reporting for calendar year (CY) 2019.

Figure 16. CY 2019 well locations in the regional groundwater monitoring, domestic well testing, and public water supplier monitoring programs.



5.1.3. 2021 Gap Analysis

The goal of this 2021 data gap is to identify gaps and redundancies in the water quality monitoring network by spatially evaluating the well distribution using well density evaluation and Thiessen polygon analysis. This gap analysis also evaluates wells that have been lost over the years. These methods and results are discussed in more detail next.

5.1.3.1. Well Density Evaluation

According to DWR's *Monitoring Networks and Identification of Data Gaps Best Management Practice*[5], if management areas are established, the quantity and density of monitoring sites in established management areas is sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area. This DWR guidance document explains that there is no definitive rule for the density of groundwater monitoring points needed in a basin. Similarly, Table 2[6] summarizes a range of recommendations from historical studies about monitoring well density to adequately characterize groundwater conditions. These recommendations range about two orders of magnitude from 0.2 to 10 monitoring wells per 100 square miles (Table 2) and indicate there is no definitive guideline for monitoring well density.

Table 2. Monitoring Well Density Considerations

Reference	Monitoring Well Density (wells per 100 square miles)
Heath (1976)	0.2 - 10
Sophocleous (1983)	6.3
Hopkins (1984) Basins pumping more than 10,000 acre-feet/year (AFY) per 100 square miles	4
Basins pumping between 1,000 and 10,000 AFY per 100 square miles	2
Basins pumping between 250 and 1,000 AFY per 100 square miles	1
Basins pumping between 100 and 250 AFY per 100 square miles	0.7

Based on CY 2019 data, approximately 68,800 and 11,100 AFY of groundwater is pumped from the Santa Clara and Llagas subbasins, respectively (2019 AGR). However, annual pumping from 2010 to 2020 has ranged from about 67,000 to 125,000 AFY in the Santa Clara Subbasin and from about 39,500 to 47,500 AFY in the Llagas Subbasin. Based on these pumping ranges and the subbasin areas of 297 square miles for the Santa Clara Subbasin and 88 square miles for the Llagas Subbasin, the recommendations in Table 2, according to Hopkins, indicates at least four monitoring wells per 100 square miles in both the Santa Clara and Llagas subbasins. According to Heath, one to ten is sufficient per 100 square miles. The estimates in Table 2 provide guidance, but the actual well density needed for monitoring depends on the local groundwater conditions in each management area.

Figures 17 and 18 show the Santa Clara Plain management area and Llagas Subbasin subdivided into 100 square mile quadrants, and these maps indicate that the current density of wells in the regional groundwater quality monitoring program meet the Heath's and Hopkins' well density recommendations outlined in Table 2. Some of the quadrants have less than four monitoring wells, but the area of aquifer in those quadrants is also less than 100 square miles. All quadrants have more than one monitoring well.

[5] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf

[6] adopted from the CASGEM Groundwater Elevation Monitoring Guidelines (DWR, 2010)

Based on this well density evaluation, the quantity and density of monitoring sites in established management areas is sufficient to evaluate conditions of the basin setting.

Figure 17. Density of regional groundwater quality monitoring wells in the Santa Clara Subbasin subdivided into 100 square mile quadrants.

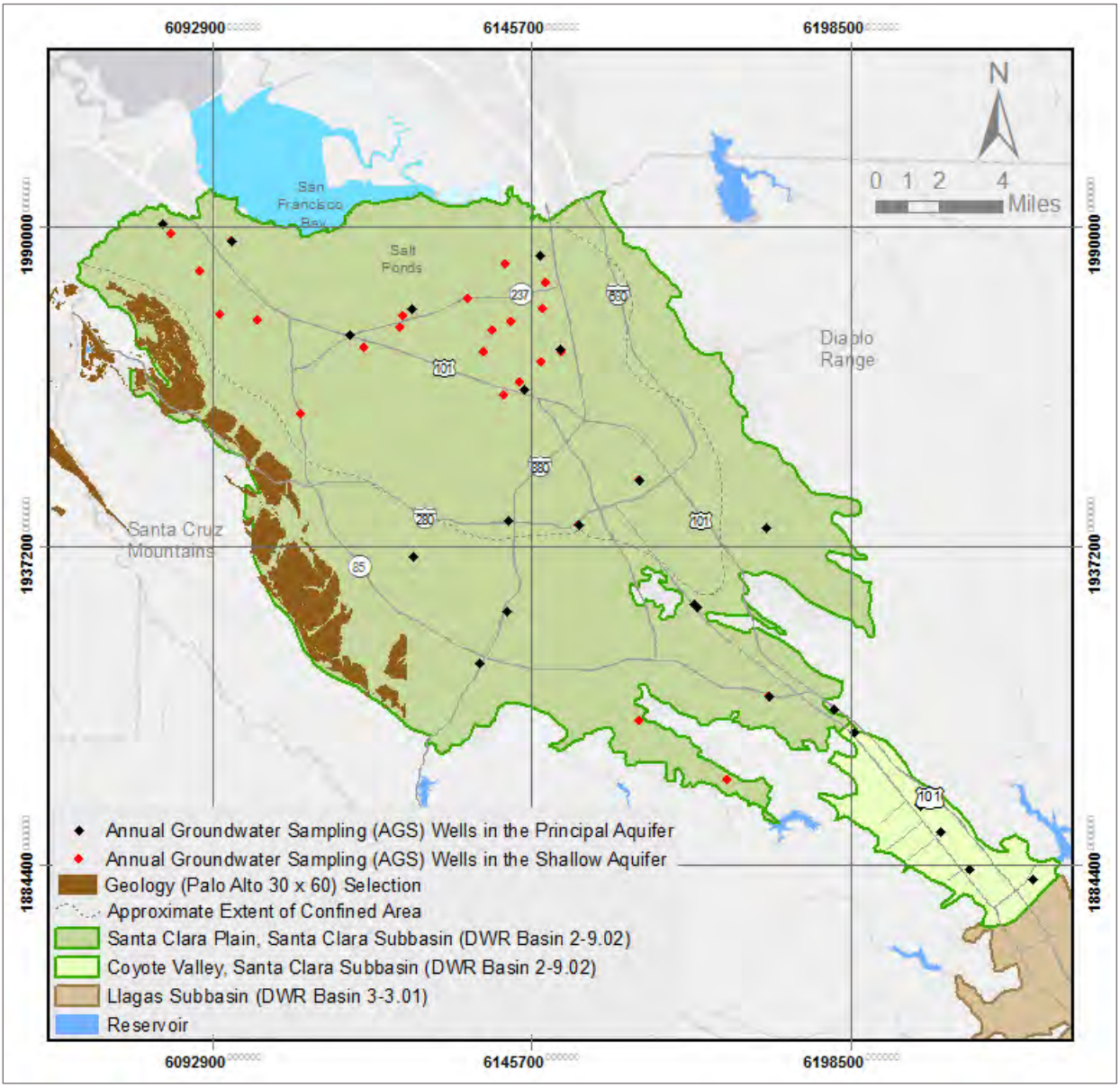
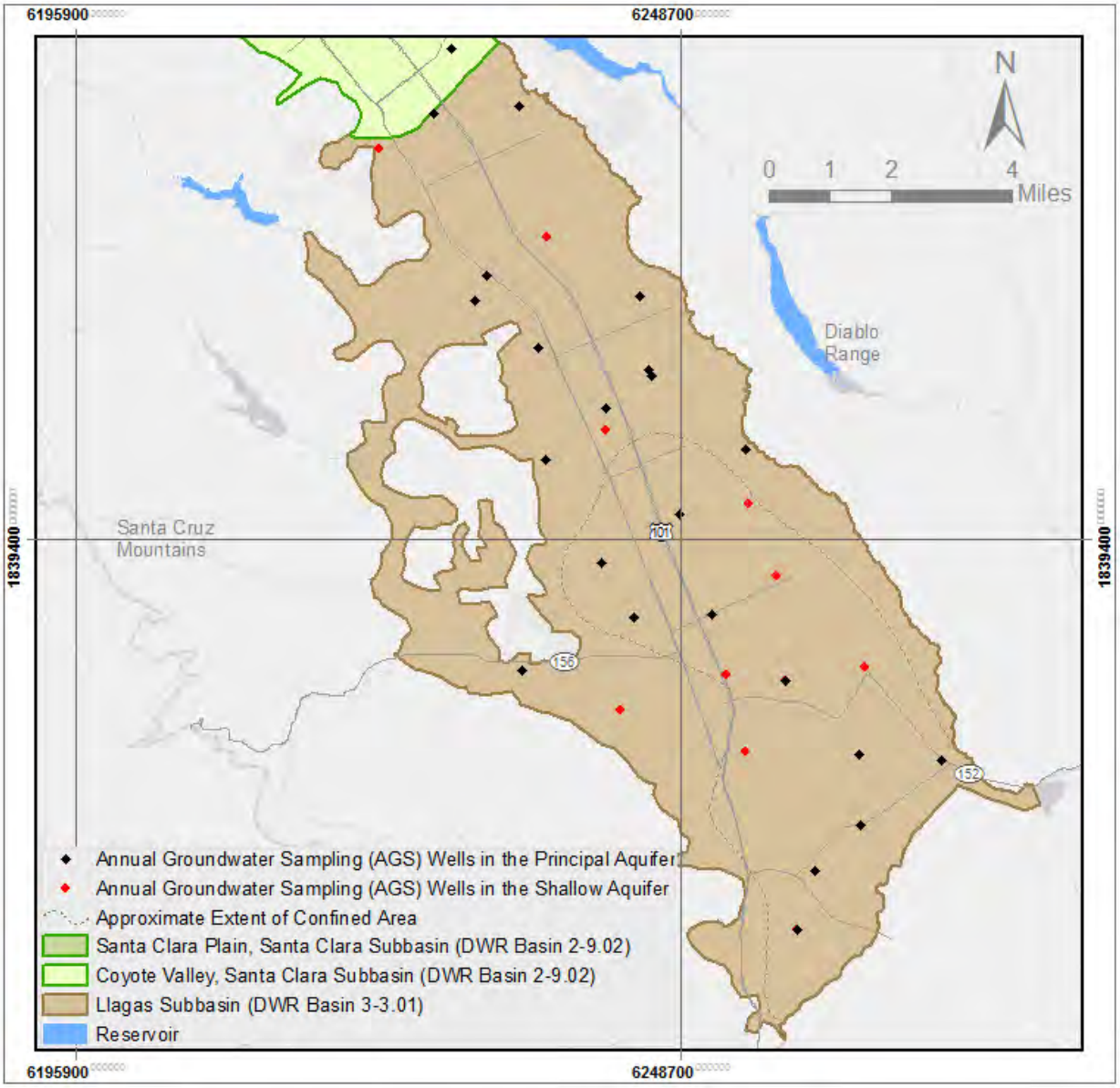


Figure 18. Density of regional groundwater quality monitoring wells in the Llagas Subbasin subdivided into 100 square mile quadrants.



5.1.3.2. Theissen Polygon Analysis

To identify potential gaps in the current regional groundwater quality monitoring program, Thiessen polygon analysis was conducted using the Thiessen polygon Arc GIS tool. Theissen polygons are an essential method for the spatial analysis of proximity and neighborhood of point features within a given network. Thiessen polygons are used to allocate space to the nearest point feature and help to define an area around a point, where every location within the polygon is nearer to this point than to all the others. The size of a Thiessen polygon indicates the relative area of influence for a given point

feature. For example, if a well has a relatively large area of influence (i.e, relatively large Thiessen polygon) and is a great distance from another well, additional well(s) may be required in the spatial gaps of those large Thiessen polygons to improve the spatial coverage of the monitoring network. Figures 19 and 20 show the results of the Thiessen polygon analysis for the regional groundwater quality monitoring program in both the principal aquifer zone and shallow aquifer zone, respectively.

Figure 19. Results of the Thiessen polygon analysis for the regional groundwater quality monitoring program in the principal aquifer zone.

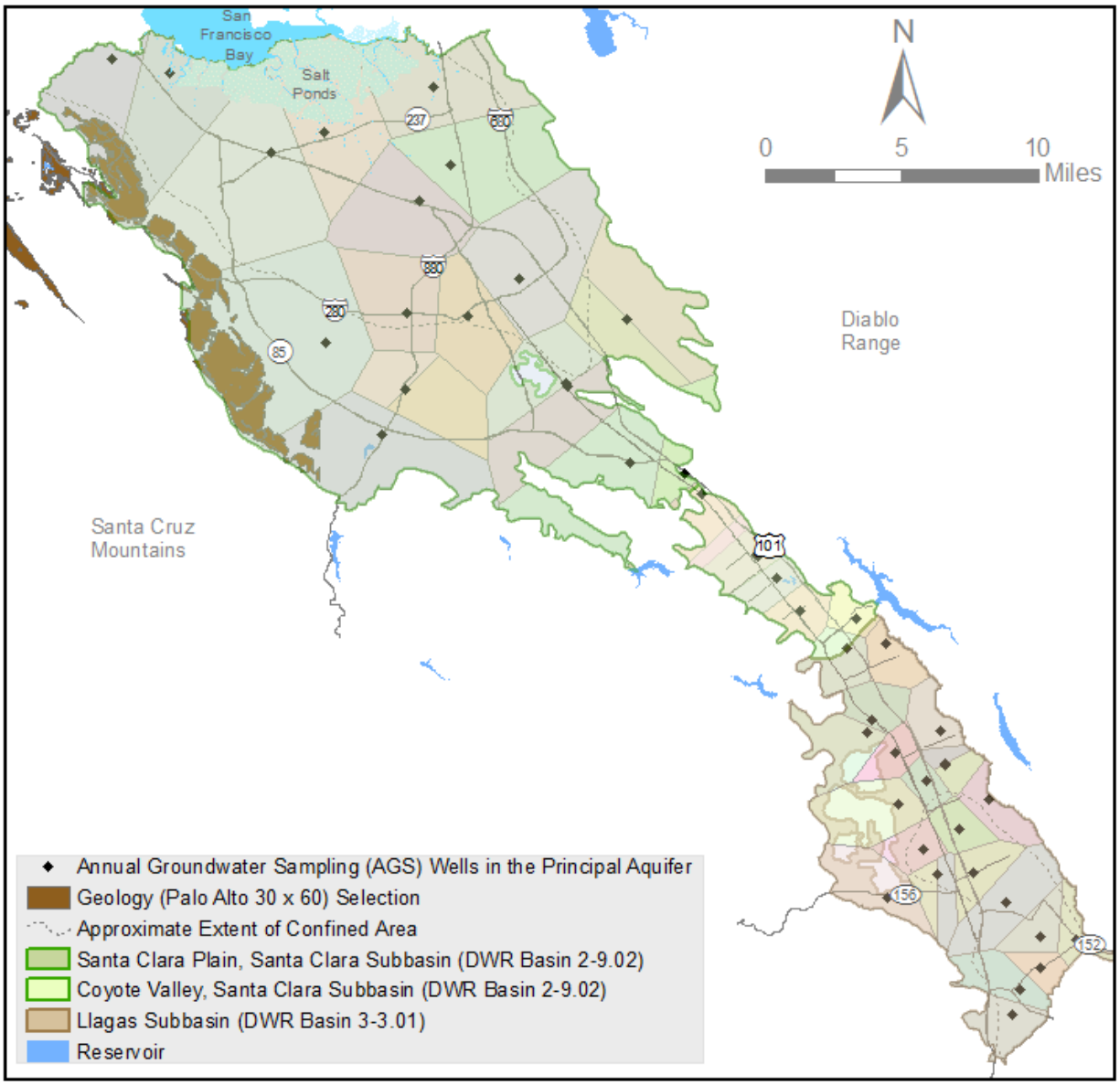
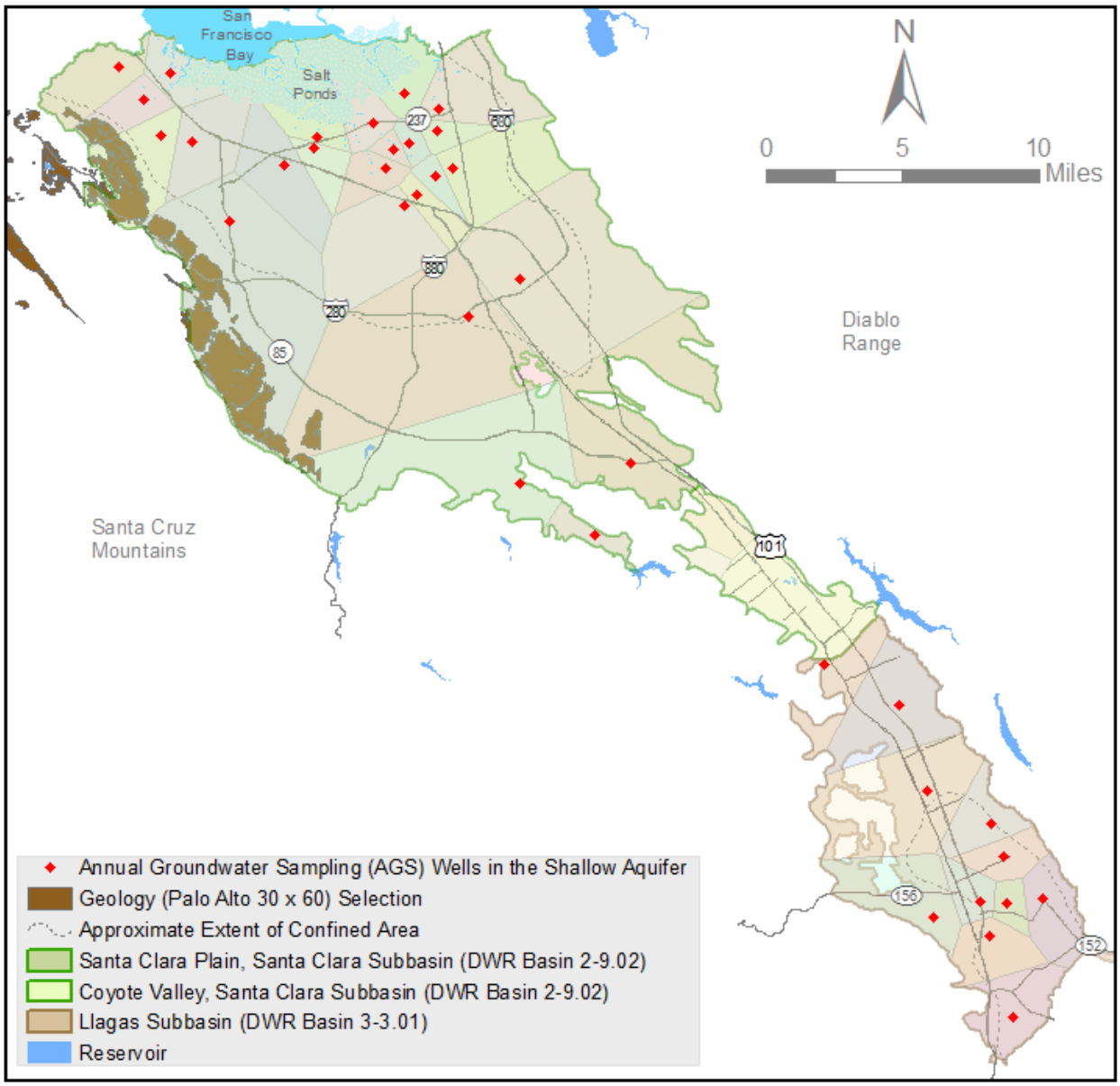


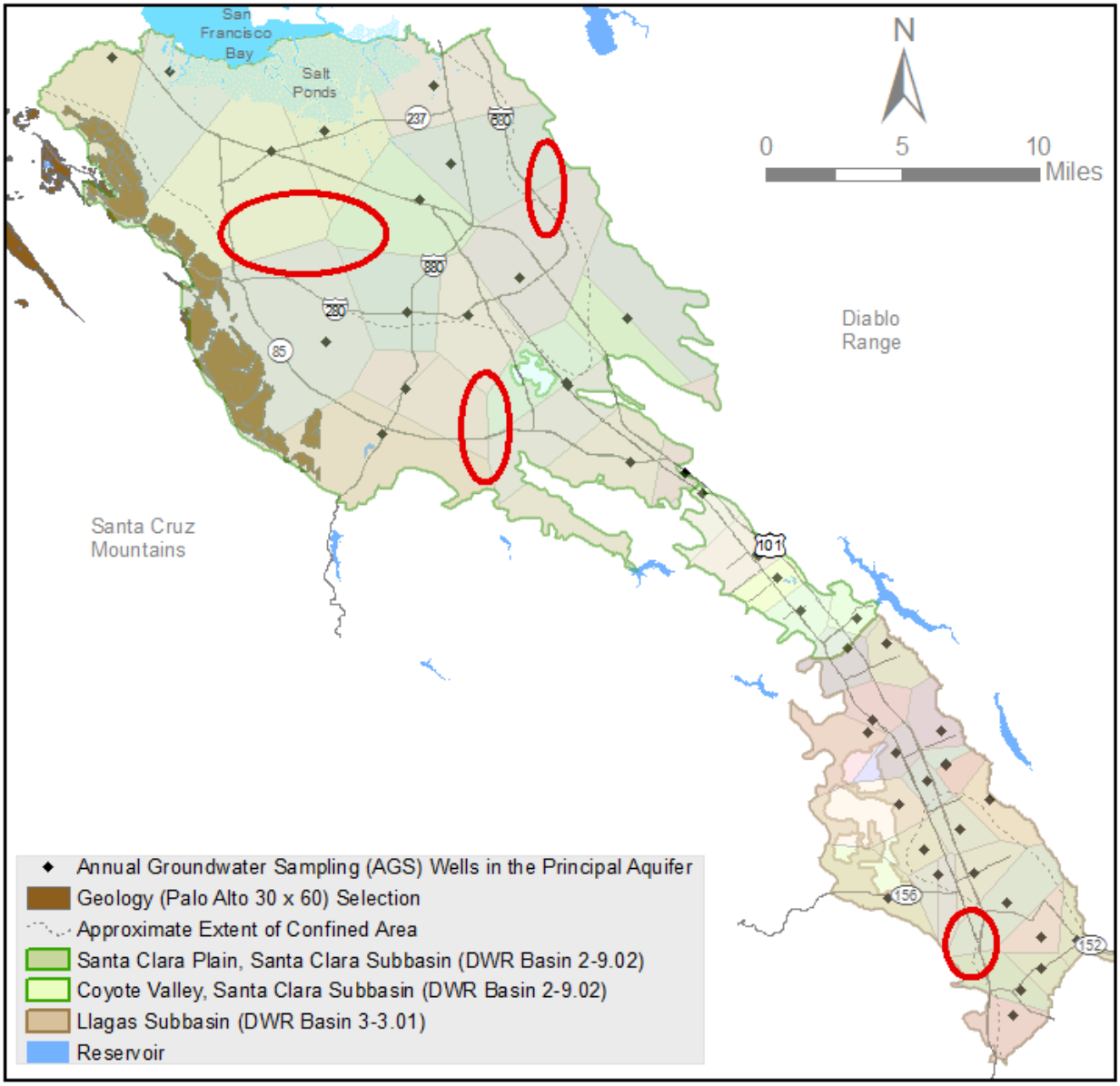
Figure 20. Results of the Thiessen polygon analysis for the regional groundwater quality monitoring program in the shallow aquifer zone.



The Thiessen polygon analysis (Figures 19 and 20) in conjunction with professional judgment was used as a visual tool to determine spatial gaps in the regional groundwater quality monitoring program. The Santa Clara Formation was excluded from the visual spatial gap analyses. The Santa Clara Formation is composed of fluvial boulder to pebble gravel, sandstone, and siltstone locally including thin bedded lacustrine mudstone and is not ideal for monitoring groundwater basin conditions. The depth of the alluvial aquifer system and the depth of the effective groundwater flow system remain uncertain in the Santa Clara Formation. The results of the gap analysis are described next.

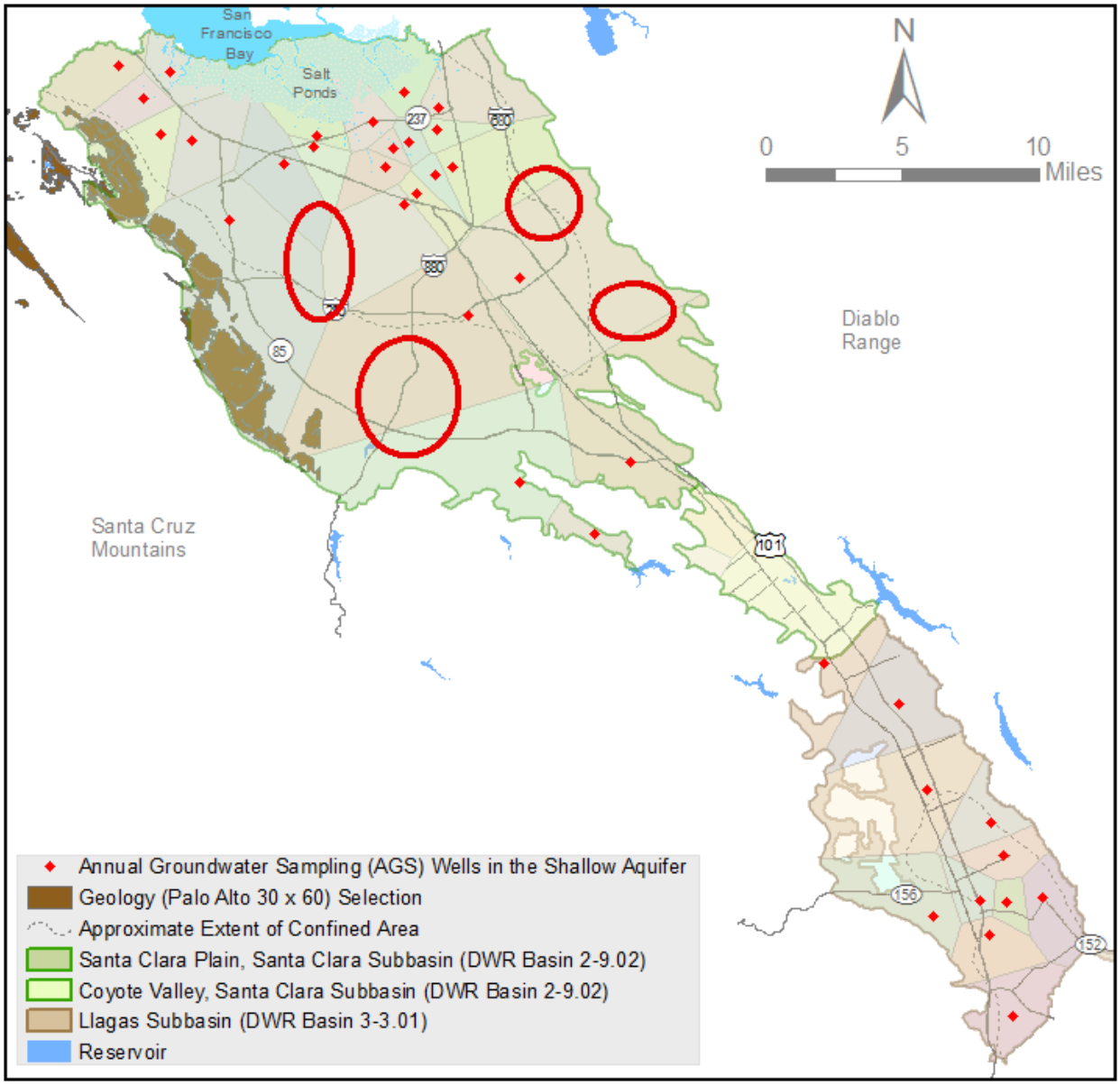
In both the principal and shallow aquifer zones, four gaps were identified (Figures 21 and 22, respectively). There are relatively more gaps identified in the Santa Clara Plain, as compared to South County for both the principal and shallow aquifer zones. Within each gap, existing water supply and monitoring wells were evaluated for well depth, well type, and accessibility. Monitoring wells that are within the immediate vicinity of an active cleanup site (evaluated using Geotracker[7]) were eliminated from this analysis.

Figure 21. Spatial gaps identified in the regional groundwater quality monitoring program in the principal aquifer zone.



[7] https://geotracker.waterboards.ca.gov/

Figure 22. Spatial gaps identified in the regional groundwater quality monitoring program in the shallow aquifer zone.



5.1.3.3. Recommendations for the Santa Clara Subbasin Principal Aquifer

Three gaps were identified in the principal aquifer of the Santa Clara Plain groundwater management area, while no gaps were identified in the Coyote Valley groundwater management area of the Santa Clara Subbasin (Figure 21). All gaps are named according to cardinal directions within each subbasin. These three gaps and recommended wells to fill the gaps are described next.

Northwest Gap. The northwest gap is in the confined area of the Santa Clara subbasin in the vicinity north of highway 280 and east of highway 85 near Sunnyvale-Saratoga Road. Water level wells 07S01W08D001 (BK-3) and 07S01W08D003 (BK-2) are acceptable options to fill this data gap.

Northeast Gap. The northeast gap is in the confined and unconfined area of the Santa Clara subbasin in the vicinity of highway 680 between Berryessa and highway 237. Three existing water level wells are within this gap; however only one well provides easy access and is recommended to be added to the water quality sampling network (06S01E27M006, Penitencia).

Southern Gap. The southern gap is in the recharge area of the Santa Clara Subbasin in the vicinity of highway 85, west of Almaden Expressway, San Jose. Water level well 08S01E08R001 (Pioneer HS) is an acceptable option and it is recommended to add to the well to the water quality network.

5.1.3.4. Recommendations for the Santa Clara Subbasin Shallow Aquifer

Four gaps were identified in the shallow aquifer of the Santa Clara Plain groundwater management area of the Santa Clara Subbasin (Figure 22). These four gaps and recommended wells to fill the gaps are described next. Sixteen designated seawater intrusion monitoring wells located near San Francisco Bay were included in the initial Thiessen analysis; however, they were excluded from the spatial analyses. These wells do not skew the results because data gaps are identified to the lateral edges of the subbasin near the Santa Cruz and Mount Diablo mountain ranges, and not near San Francisco Bay.

Northeast Gap. The northeast gap is located at the boundary of the confined/unconfined area of the Santa Clara Subbasin in the vicinity of highway 680, McKee Road, and Hostetter Road, San Jose. Ten wells with known well construction were identified; however, all wells are associated with contamination clean-up sites. Background monitoring wells associated with these sites can be used if access is granted. Otherwise, it is recommended to construct a new shallow aquifer monitoring well in the northeast gap.

Northwest Gap. The northwest gap is located mostly in the unconfined area of the Santa Clara Subbasin north of highway 280 in the vicinity of Lawrence Expressway, Cupertino. 122 wells with known well construction were identified. Most wells are associated with contamination clean-up sites and are not ideal for shallow groundwater quality monitoring. One well is located on Valley Water property and six wells are located on City property. These wells are potential candidates for the monitoring network program.

Southeast Gap. The southeast gap is in the recharge area of the Santa Clara Subbasin on the east side of highway 101 and Capitol Expressway, San Jose. Eight wells with known well construction were identified; however only one private domestic well (07S02E17G006) is not associated with a groundwater contamination cleanup site. It is recommended to pursue an access agreement with the property owner.

Southwest Gap. The southwest gap is in the recharge area of the Santa Clara Subbasin north of highway 85 in the vicinity of highway 17 in Campbell. It is recommended to add water level monitoring well 07S01W34G003 (Morgan Park #2) or 08S01W03K013 (Dell Avenue) to the water quality monitoring program. Well 07S01W34G003 is preferred over the other Morgan Park wells, which either tend to have sufficient water in the well casing for sampling or contain calcium carbonate buildup inside the well casing.

5.1.3.5. Recommendations for the Llagas Subbasin Principal Aquifer

One gap was identified in the principal aquifer zone of the Llagas Subbasin in the vicinity of highway 101 at the intersection of Monterey Highway, Gilroy (Figure 21). It is recommended to add water level well 11S04E07F004 (Uvas Creek) to the water quality network.

5.1.3.6. Recommendations for the Llagas Subbasin Shallow Aquifer

There were no gaps identified using the Thiessen analyses in the shallow aquifer zone of the Llagas Subbasin (Figure 22). The groundwater benefit zone W-5 is located generally from Morgan Hill to the Pajaro River in the Llagas Subbasin. However, we currently do not have any monitoring wells within the groundwater benefit zone W-8 below Uvas and Chesbro Reservoirs. Ideally, we recommend filling this gap with at least one well below Uvas Reservoir and one well below Chesbro Reservoir. Ten privately owned wells with historical water quality data have been identified to fill this deficiency.

5.1.3.7. Replace Existing Monitoring Network Wells

Over the years, several wells have been lost from the regional groundwater quality monitoring program due to various reasons, primarily because access agreements have expired or due to concerns surrounding well construction and reliability. Currently, a total of 12 wells within the regional groundwater quality monitoring program need to be replaced, which are listed in Table 3. Of these 12 wells, eight are located in the Santa Clara Subbasin and four are located in the Llagas Subbasin. Of these 12 wells, a total of eight wells are located in the principal aquifer zones (Figure 23) and four wells are located in the shallow aquifer zones (Figure 24) of the Santa Clara and Llagas subbasins. The location of these 12 wells are shown in reference to the previously discussed spatial gaps (Figure 23 and 24).

Table 3. Wells from the Regional Groundwater Quality Monitoring Program that Need to be Replaced

Well ID	Currently Sampled	Aquifer Zone
Santa Clara Plain		
06S01E35M011	No	Principal
06S01W24H015	Yes	Principal
06S01W36D004	No	Shallow
06S02W05F002	Yes	Shallow
06S02W09K021	No	Shallow
06S02W24C008	Yes	Principal
Coyote Valley		
09S02E02C001	No	Principal
09S03E17B005	No	Principal
Llagas Subbasin		
09S03E36B007	No	Principal
11S04E05H002	Yes	Principal
11S04E08K002	No	Principal
11S04E17N004	No	Shallow

Figure 23. Regional Groundwater Quality Monitoring Program Wells in the Principal Aquifer Zone that Need to be Replaced.

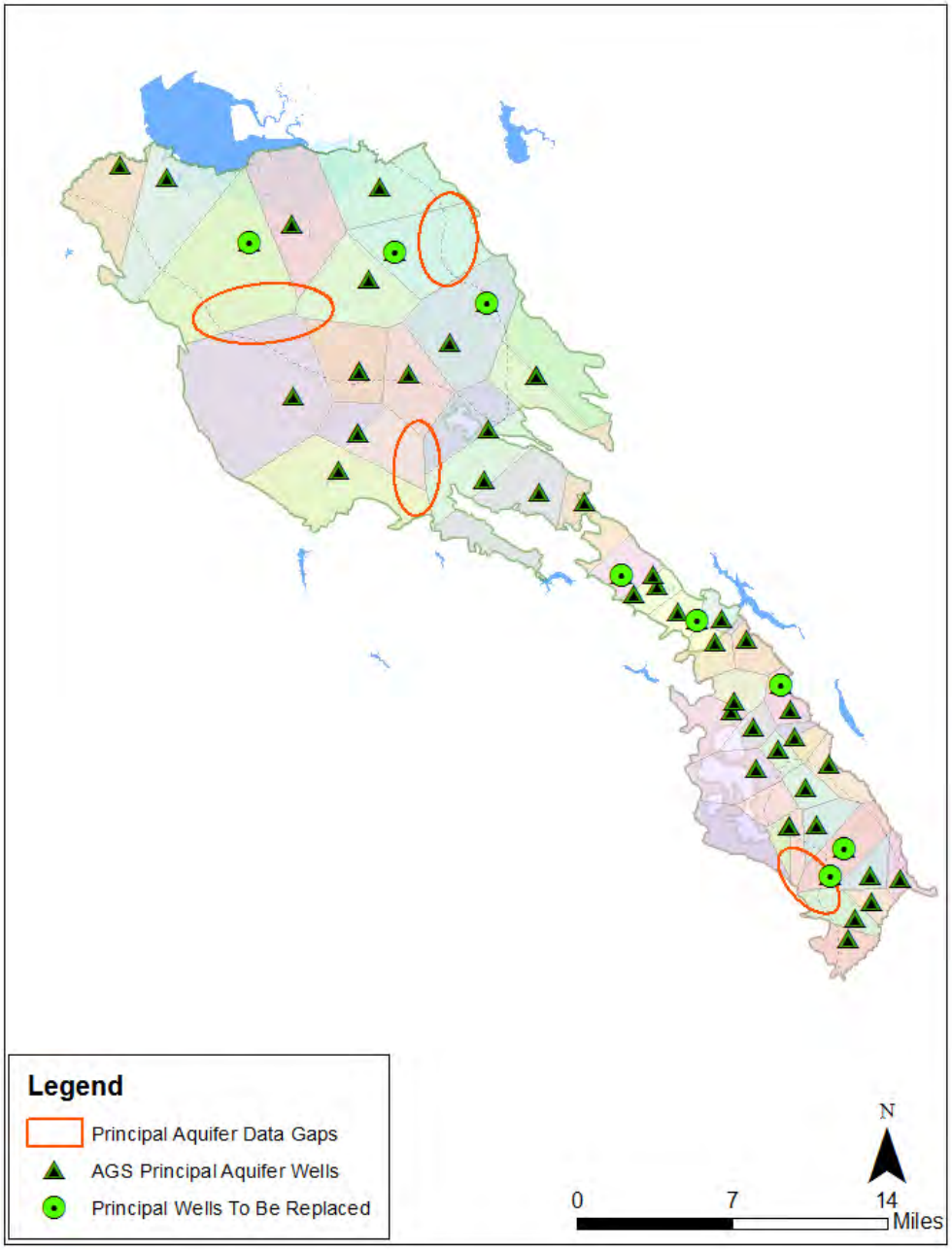
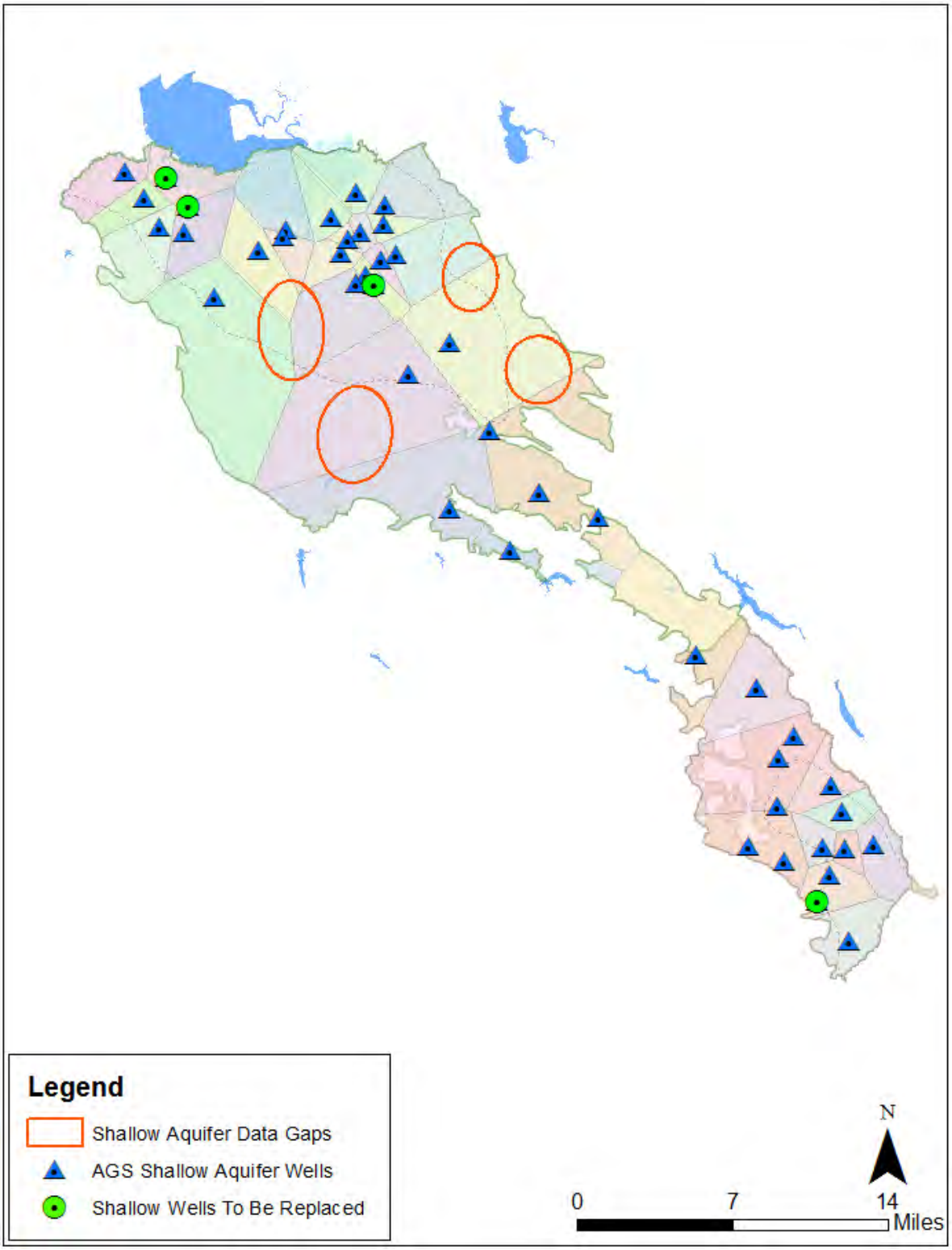


Figure 24. Regional Groundwater Quality Monitoring Program Wells in the Shallow Aquifer Zone that Need to be Replaced.



To identify possible replacement wells, a ½-mile radius search was conducted around each of the 12 wells needing replacement for water supply and monitoring wells with corresponding subbasin, aquifer zone, and similar well construction with depths greater than 50 feet bgs (below ground surface). Monitoring wells that are within the immediate vicinity of an active cleanup site were eliminated. The results of this analysis are summarized below and organized based on the list in Table 3.

5.1.3.7.1. Replacement Wells in the Santa Clara Plain

Well 06S01E35M011 has an expired access agreement and was last sampled on 10/26/2017. There are two potential well replacements available in the vicinity of this well. Both wells are privately owned and access may be restricted. Water level well 07S01E03H001 may be an alternate solution.

Well 06S01W24H015 is an artesian well with a high purge volumes and purge rates. A safe location to purge the water does not exist. There are three nearby domestic and agricultural wells that could replace this well if access can be secured.

Well 06S01W36D004 has a bent casing and was last sampled on 10/8/2009. An alternate solution is well 06S01W26K001, approximately 2,800 feet to the north and is already sampled as part of the AGS program; however, it is recommended to attempt to repair the well casing of this well so it can be sampled again and used for other monitoring programs.

Well 06S02W05F002 is a small 1-inch diameter well where the sample is collected using a bailer. Sample collection using a bailer is not ideal for the recommended turbidity needed for sample analysis. There are three shallow wells on the same property that could replace this well. Further investigation is warranted into the accessibility of the well and sample collection port.

Well 06S02W09K021 was destroyed in 2018. There are approximately 20 monitoring wells within ½-mile radius of this well with similar well construction.

Well 06S02W24C008 is a telemetry well with very long purge times and high turbidity readings. There are no wells with similar well construction in the vicinity of this well. It is recommended to construct a new well to replace this current monitoring well.

To summarize the recommendations from the six wells in the Santa Clara Plain that need to be replaced (Table 3):

- 1 well requires maintenance or other repairs before sampling can resume,
- 2 wells have one to three clear options for replacement by existing wells,
- 1 well has many options for replacement by existing wells,
- 1 well may require a newly constructed monitoring well, and.

Four of the six wells have possible options for replacement, which will require additional time from Valley Water to identify the most appropriate option(s) and acquire new access agreements.

5.1.3.7.2. Replacement Wells in the Coyote Valley

Well 09S02E02C001 is an older agricultural well no longer in use. Without the electrically powered pump, it is difficult to collect a well sample as water is no longer pumped into the water tanks. Water tank sample collection is also not ideal. There are a limited number of domestic wells in the vicinity of this well with known well construction information. It is recommended to modify the well head of well

09S02E02C001 to allow for proper well sample collection. If this is not possible, a newly constructed well is recommended.

Well 09S03E17B005 is no longer sampled due to failed attempts at securing a new access agreement. It was last sampled on 10/30/2017. There are approximately 20 wells with similar well construction in the vicinity of this well. It is recommended to secure a new access agreement with the property owner of one of these wells.

To summarize the recommendations from the two wells in Coyote Valley that need to be replaced (Table 3):

- 1 well requires maintenance or other repairs before sampling can resume, or may require a newly constructed monitoring well, and
- 1 well has many options for replacement by existing wells.

Both wells will require additional time to identify the most appropriate option(s) and acquire new access agreements.

5.1.3.7.3. Replacement Wells in the Llagas Subbasin

Well 09S03E36B007 is no longer sampled due to failed attempts at securing a new access agreement. It was last sampled on 10/18/2017. There are approximately 40 wells with similar well construction in the vicinity of this well. It is recommended to secure a new access agreement with the property owner of one of these wells.

Well 11S04E05H002 will no longer be sampled due to a deteriorating steel casing. There are approximately 14 wells with similar well construction in the vicinity of this well. It is recommended to secure a new access agreement with the property owner of one of these wells.

Well 11S04E08K002 is no longer sampled due to failed attempts at securing a new access agreement. It was last sampled on 10/27/2016. There are approximately 5 wells with similar well construction in the vicinity of this well. It is recommended to secure a new access agreement with the property owner of one of these wells.

Well 11S04E17N004 is no longer sampled due to failed attempts at securing a new access agreement. It was last sampled on 10/26/2017. There are no wells within the vicinity with similar well construction. It is recommended to construct a new well to replace this current monitoring well.

To summarize the recommendations from the four wells in the Llagas Subbasin that need to be replaced (Table 3):

- 3 wells have many options for replacement by existing wells and will also require new access agreements, and
- 1 well may require a newly constructed monitoring well.

All four wells have several possible options for replacement, which will require additional time to identify the most appropriate option(s) and acquire new access agreements.

5.1.4. Data Gap Well Replacement Prioritization

Some areas are prioritized over others. These areas are defined by lack of well availability and overlap with data gaps identified in other monitoring network programs. Prioritization will be discussed further in the conclusions section.

5.1.5. Water Quality Data Redundancies

Based on the spatial gap analysis described above, redundancies in the monitoring network were not identified. However, Valley Water will further evaluate the use of the regional groundwater quality monitoring program data in conjunction with water quality data from other sources such as Valley Water's domestic well testing program and data downloaded from the DDW database. Each year, Valley Water obtains groundwater quality data from DDW for all public water systems in Santa Clara County, including water retailers and mutual water companies subject to DDW requirements.

Water quality data is used in the annual evaluation of regional groundwater quality conditions for the shallow and principal aquifers of the Santa Clara and Llagas Subbasin. The data also helps to evaluate the extent and severity of contamination, including the presence of contaminants above drinking water standards, changes in water quality and water levels over time, and potential threats to the long-term viability of groundwater resources.

There is a greater density of DDW data in the central area of the Santa Clara Plain and a greater density of DWT data in the Llagas subbasin. The water quality data redundancy evaluation will include a qualitative analysis on whether a fixed network without DDW data or using select DDW indexed wells is an improved data selection, and whether select data for trend analysis should be used due to high dense areas potentially skewing results. Evaluation in data redundancies will include DDW program analytes from the past five years.

5.2. Domestic Well Testing Program

The domestic well testing (DWT) program is an ongoing free voluntary program for well owners within Valley Water's groundwater benefit zones. The program benefits Valley Water by providing more localized information on nitrate and other parameters to supplement regional groundwater monitoring data. The program was first implemented to better understand the occurrence of nitrate and to help well owners better understand their water quality but also includes other basic water quality parameters like bacteria, hardness, total dissolved solids, fluoride, and sulfate. Spatial data gaps were not evaluated for the domestic testing program because the well selection is dependent on customer participation. No data gaps were identified for the purpose of this gap analysis.

5.3. Recycled Water Monitoring Program

Valley Water currently monitors wells at several sites where recycled water is used for irrigation in the Llagas Subbasin to ensure the groundwater resources are protected. Valley Water also evaluates data collected by South Bay Water Recycling (SBWR) from monitoring wells near sites of recycled water irrigation located in the Santa Clara Subbasin. Valley Water has a recycled water monitoring program because tertiary-treated recycled water generally has a higher concentration of salts, nutrients, disinfection by-products, and emerging contaminants than local groundwater or treated potable water. Recycled water is used for non-potable uses like landscape irrigation, agriculture, and industry. Valley

Water conducted a recent evaluation of the recycled water monitoring program, and recommendations from this evaluation have been incorporated into Chapter 7 of the 2021 GWMP.

5.4. Seawater Intrusion Monitoring

Recommended seawater intrusion monitoring is described in detail in Appendix H of the 2021 GWMP and in section 3.5 (Recommendations for the Water Level Monitoring Network) of this gap analysis.

6. Surface Water Monitoring

Valley Water surface water monitoring network includes recharge water quality monitoring and stream-gauging, as well as surface water monitoring data from other agencies. The focus of the gap analysis here on the recharge water quality monitoring network. The purpose of the Valley Water's recharge water quality monitoring is to assess the quality of water used for managed recharge at Valley Water facilities and whether changes to existing monitoring programs or recharge operations are necessary to protect groundwater. Valley Water conducted a recent (2018) evaluation of the recharge water quality monitoring program, and recommendations from this evaluation have been implemented in the 2021 GWMP.

7. Conclusion and Recommendations

This gap analysis demonstrates that Valley Water's comprehensive monitoring networks provide appropriate spatial and temporal information to support a strong understanding of groundwater conditions and inform decision-making. As part of the adaptive management strategy, Valley Water will continue to regularly evaluate data gaps and redundancies, monitoring procedures, and associated data management, evaluation, and reporting. While individual wells or analytical parameters may vary or evolve within the networks as part of adaptive management, the groundwater monitoring programs consistently provide high quality and comprehensive data to evaluate outcome measures within the Santa Clara and Llagas subbasins. These regular evaluations of monitoring gaps and redundancies will be reported and summarized in each five-year update of the GWMP.

In general, Valley Water has a comprehensive and complementary set of monitoring networks. This gap analysis identified a relatively small number of gaps and few, if any redundancies in the monitoring networks. The gap analysis outlines recommendations for filling the gaps in the following sections:

- water level monitoring network in section 3.5,
- subsidence monitoring network in section 4.4,
- groundwater quality monitoring networks in sections 5.1.3.2 to 5.1.3.5 and 5.1.3.6.1 to 5.1.3.6.3.

8. References

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Appendix K – Monitoring Well Details

Table K-1. Santa Clara Subbasin Groundwater Level Monitoring Network Wells Monitored by Valley Water

Table K-2. Llagas Subbasin Groundwater Level Monitoring Network Wells Monitored by Valley Water

Table K-3. Santa Clara Subbasin Groundwater Quality Monitoring Network

Table K-4. Llagas Subbasin Groundwater Quality Monitoring Network

Table K-5. Llagas Subbasin Recycled Water Monitoring Network

Table K-1. Santa Clara Subbasin Groundwater Level Monitoring Network

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
05S02W32E002	NA	37.45815	-122.10858	218	185	198	7.94	9.54	P	MON (was AG)	ES	M	Other
05S02W35R001	374470N1220460W001	37.44703	-122.04602	300	190	280	7.54	7.44	P	MON (was AG)	ES	M	Valley Water
05S02W35R002	374471N1220460W001	37.44708	-122.04602	80	60	80	7.54	7.32	S	MON (was AG)	ES	M	Valley Water
05S03W36P002	374502N1221430W001	37.45552	-122.15506	930	830	850	24.42	24.02	P	MON	PT	D	Valley Water
05S03W36P003	374502N1221430W002	37.45085	-122.14287	740	720	740	24.42	23.62	P	MON	PT	D	Valley Water
05S03W36P004	374502N1221430W003	37.45024	-122.14299	560	540	560	24.42	23.52	P	MON	PT	D	Valley Water
05S03W36P005	374502N1221430W004	37.45024	-122.14299	200	180	200	24.42	23.59	P	MON	PT	D	Valley Water
06S01E21M011	373938N1218748W001	37.39383	-121.87482	325	UK	UK	100.77	100.43	P	MON (was AG)	ES	M	Valley Water
06S01E22P002	NA	37.39241	-121.85084	519	UK	UK	182.11	181.64	P	MON (was AG)	ES	M	Other
06S01E27M006	373817N1218562W001	37.38175	-121.85615	262	UK	UK	154.44	153.99	P	MON (was AG)	PT	D	Valley Water
06S01E27P002	373772N1218499W001	37.37721	-121.84994	388.5	UK	UK	152.58	152.29	P	AG	PT	D	Valley Water
06S01E32M005	NA	37.36453	-121.89284	110	UK	UK	63.69	63.69	S	DO	ST	M	Other
06S01W01M001	374376N1219291W001	37.43819	-121.92840	265	255	265	22.86	24.97	P	MI	PT	D	Valley Water
06S01W10N007	374183N1219686W001	37.36520	-121.90277	82.5	73	78	12.6	12.73	S	MON	PT	D	Valley Water
06S01W11B003	NA	37.43055	-121.93868	UK	UK	UK	9.28	11.63	UK	MI	PG	M	Other
06S01W13C009	374143N1219256W001	37.41434	-121.92556	51	40	46	36.29	36.12	S	MON	PT	D	Valley Water
06S01W14P008	NA	37.43439	-121.94788	392	UK	UK	13.02	12.02	P	MON (was AG)	PG	M	Other
06S01W17F001	374132N1220007W001	37.41317	-122.00065	110	90	100	2.4	1.75	S	MON	PT	D	Valley Water
06S01W17F002	374132N1220007W002	37.41317	-122.00068	210	190	200	2.47	2.24	P	MON	PT	D	Valley Water
06S01W24H010	NA	37.42634	-121.92452	131	UK	UK	38.93	39.18	S	AG	ST	M	Valley Water
06S01W24H015	373962N1219156W001	37.39616	-121.91556	227	UK	UK	42.75	42.3	P	MON (was AG)	PT	D	Valley Water
06S01W24J037	NA	37.40819	-121.94386	65	56	61	46.13	45.8	S	MON	PT	M	Valley Water
06S01W26K001	373804N1219385W001	37.38043	-121.93854	65	55	60	35.81	34.9	S	MON	PT	D	Valley Water

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
06S01W26P002	373738N1219428W001	37.40423	-121.95418	450	190	430	36.52	42.52	P	MI	ES	M	Valley Water
06S01W26R001	373776N1219362W001	37.37762	-121.93618	1360	810	830	31.36	32.51	P	MON	PT	M	Valley Water
06S01W26R002	373776N1219362W002	37.37763	-121.93618	600	580	600	31.36	32.6	P	MON	PT	M	Valley Water
06S01W26R003	373776N1219362W003	37.40997	-122.00554	460	440	460	31.36	32.6	P	MON	PT	M	Valley Water
06S01W26R004	373776N1219362W004	37.40458	-122.00727	330	310	330	31.36	32.66	P	MON	PT	M	Valley Water
06S01W35L001	373640N1219417W001	37.39443	-121.95919	458	UK	UK	43.59	43.39	P	MON	ES	M	Valley Water
06S02W05F001	374429N1221039W001	37.39490	-121.95789	31	21	31	6.76	8.46	S	MON	ES	M	Valley Water
06S02W05F002	374429N1221039W002	37.39606	-121.94585	50	40	50	6.76	8.36	S	MON	ES	M	Valley Water
06S02W05F003	374429N1221039W003	37.40327	-121.91985	200	190	200	6.76	8.76	P	MON	PT	D	Valley Water
06S02W07B023	NA	37.40203	-121.91889	45	28	45	14.49	13.34	S	MON	PT	D	Valley Water
06S02W16L021	374069N1220886W001	37.39946	-121.92819	40	20	40	38.08	37.65	S	MON	PT	D	Valley Water
06S02W18J001	374090N1221168W001	37.39927	-121.93010	46	UK	UK	47.45	47.16	S	MON	PT	D	Valley Water
06S02W19B002	NA	37.40129	-122.12326	295	110	292	84.02	84.94	P	MI	ES	M	Other
06S02W22G004	373992N1220645W001	37.39616	-121.91556	285.5	265	285	62.59	62.36	P	MON	ES	M	Valley Water
06S02W22G005	373992N1220645W002	37.39918	-122.06453	449	414	449	62.65	62.42	P	MON	ES	M	Valley Water
06S02W22G006	373992N1220645W003	37.39027	-121.92647	333	303	333	62.53	62.42	P	MON	ES	M	Valley Water
06S02W22H012	373975N1220614W001	37.38749	-121.94789	360	314.5	359.5	64.91	64.63	P	MON	ES	M	Valley Water
06S02W22H014	373975N1220613W001	37.39751	-122.06134	420	374.5	419.5	64.59	64.19	P	MON	ES	M	Valley Water
06S02W22H015	NA	37.37486	-121.94703	497.5	477	497	64.74	64.24	P	MON	ES	M	Valley Water
06S02W24C008	374014N1220355W001	37.37651	-121.95000	250	UK	UK	32.33	34.83	P	MON	PT	D	Valley Water
06S02W24C009	374014N1220354W001	37.40140	-122.03539	550	UK	UK	32.08	32.88	P	MON	ES	M	Valley Water
06S02W24C010	374014N1220353W001	37.40143	-122.03530	1005	UK	UK	31.76	32.03	P	MON	ES	M	Valley Water
06S02W24J009	NA	37.39532	-122.02719	55	30	50.5	34.55	34.15	S	MON	PT	D	Valley Water
06S02W33B001	NA	37.37080	-122.08540	400	UK	UK	151.62	153.25	P	MI	ES	M	Other

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
06S02W34B006	373719N1220650W001	37.37180	-122.06485	190	UK	UK	152.03	151.55	P	MON	ES	M	Valley Water
06S02W34J001	373646N1220626W001	37.37010	-121.98740	140	120	130	169.2	169	S	MON	PT	D	Valley Water
06S03W01B010	NA	37.36315	-121.98646	101	93.5	98.5	20.25	19.23	S	MON	PT	D	Valley Water
07S01E01G001	373531N1218116W001	37.35977	-121.97276	400	UK	UK	180.47	181.37	P	MON (was AG)	PT	D	Valley Water
07S01E02J021	NA	37.35291	-121.82434	236	UK	UK	120.49	121.49	P	MON	PT	D	Valley Water
07S01E03H001	373556N1218411W001	37.35575	-121.84106	365	UK	UK	103.18	102.58	P	MON	ES	M	Valley Water
07S01E06L001	NA	37.34949	-121.90451	398	UK	UK	65.14	66.19	P	MI	ES	M	Other
07S01E09L004	373368N1218695W001	37.33677	-121.86953	1000	820	840	86.94	88.46	P	MON	PT	D	Valley Water
07S01E09L005	373368N1218695W002	37.33677	-121.86954	640	620	640	86.94	88.07	P	MON	PT	D	Valley Water
07S01E09L006	373368N1218695W003	37.33677	-121.86953	540	520	540	86.94	88.07	P	MON	PT	D	Valley Water
07S01E09L007	373368N1218695W004	37.40953	-122.10973	425	405	425	86.94	88.09	P	MON	PT	D	Valley Water
07S01E09L008	373368N1218695W005	37.40385	-122.09853	72	62	72	87.07	87.97	S	MON	PT	D	Valley Water
07S01E16C005	NA	37.32871	-121.86814	725	526	682	110.65	112.15	P	MI	PT	D	Other
07S01E16C011	373284N1218687W001	37.32838	-121.86888	1000	551	660	102.53	104.02	P	MON	PT	D	Valley Water
07S01E19B002	373162N1219032W001	37.39700	-122.11611	85	75	85	114.85	114.69	S	MON	PT	D	Valley Water
07S01E19B003	373161N1219033W001	37.39513	-122.12840	850	770	790	114.85	115.3	P	MON	PT	D	Valley Water
07S01E19B004	373161N1219033W002	37.39230	-122.10577	455	435	455	114.85	114.92	P	MON	PT	D	Valley Water
07S01E19B005	373161N1219033W003	37.38868	-122.11229	365	345	365	114.85	114.95	P	MON	PT	D	Valley Water
07S01E19B006	373161N1219033W004	37.40094	-122.09506	240	220	240	114.85	115.05	P	MON	PT	D	Valley Water
07S01E19B007	373161N1219033W005	37.39629	-122.08199	590	570	590	114.85	114.95	P	MON	PT	D	Valley Water
07S01E24P001	NA	37.28102	-121.83712	277	164	272	164.03	162.48	P	MON	ES	M	Valley Water
07S01E29J007	372916N1218802W001	37.29164	-121.88018	190	UK	UK	145.27	145.02	P	MON	ES	M	Valley Water
07S01E29Q001	372906N1218812W001	37.29059	-121.88123	154	UK	UK	145.71	145.48	P	MON	ES	M	Valley Water
07S01E32B001	372846N1218818W001	37.39630	-122.06774	250	UK	UK	149.17	148.69	P	MON	ES	M	Valley Water

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
07S01E32R003	NA	37.27398	-121.87738	350	UK	UK	159.67	158.92	P	MON	ES	M	Other
07S01E35E001	NA	37.28128	-121.83740	300	UK	UK	165.86	165.55	P	MON	ES	M	Other
07S01E35E003	372798N1218360W001	37.27977	-121.83600	148	46	146	167.84	166.92	S	MON	PT	D	Valley Water
07S01E35L004	372797N1218361W001	37.39115	-122.06924	229	181	226	167.71	167.28	P	MON	PT	D	Valley Water
07S01E36G003	372833N1218135W001	37.28331	-121.81350	134	UK	UK	164.39	164.14	S	MON	PT	D	Valley Water
07S01E36L003	NA	37.28210	-121.81877	UK	UK	UK	175.44	175.2	UK	MON	ES	M	Valley Water
07S01W08C003	373418N1220002W001	37.34181	-122.00021	398	388	398	126.93	126.43	P	MON	ES	M	Valley Water
07S01W08D001	373417N1220002W001	37.34175	-122.00020	480	460	475	127.17	127.72	P	MON	ES	M	Valley Water
07S01W08D002	373416N1220002W001	37.38317	-122.06709	340	320	335	127.51	126.78	P	MON	ES	M	Valley Water
07S01W08D003	373417N1220002W002	37.38039	-122.08598	440	420	435	127.35	127.69	P	MON	PT	D	Valley Water
07S01W09G011	NA	37.38431	-122.10591	UK	UK	UK	103.75	103.6	UK	MON	ES	M	Other
07S01W14P001	373177N1219435W001	37.37214	-122.11228	980	680	700	141.46	141.05	P	MON	PT	D	Valley Water
07S01W14P002	373177N1219435W002	37.31774	-121.94346	440	420	440	141.46	141.03	P	MON	PT	D	Valley Water
07S01W14P003	373177N1219435W003	37.31774	-121.94346	560	540	560	141.46	141.05	P	MON	PT	D	Valley Water
07S01W14P004	373177N1219435W004	37.36829	-122.06564	360	340	360	141.46	141.05	P	MON	PT	D	Valley Water
07S01W14P005	373177N1219435W005	37.31774	-121.94346	150	130	150	141.46	141.06	S	MON	PT	D	Valley Water
07S01W25L001	372938N1219233W001	37.36387	-122.06482	404	UK	UK	169.75	169.25	P	MON	ES	M	Valley Water
07S01W27P009	NA	37.36152	-122.07409	534	300	524	197.74	199.5	P	MI	PT	D	Valley Water
07S01W28R001	NA	37.28875	-121.96905	450	UK	UK	202.14	202.64	P	MI	ES	M	Other
07S01W29C003	373008N1219975W001	37.44555	-122.13834	1000	630	650	231.17	232.34	P	MON	PT	D	Valley Water
07S01W29C004	373008N1219975W002	37.44435	-122.14121	550	530	550	231.12	231.96	P	MON	PT	D	Valley Water
07S01W29C005	373008N1219975W003	37.44456	-122.16711	380	360	380	231.12	231.92	P	MON	PT	D	Valley Water
07S01W29C006	373008N1219975W004	37.43169	-122.14606	270	250	270	231.12	231.95	P	MON	PT	D	Valley Water
07S01W30C002	373003N1220143W001	37.42110	-122.13463	554	UK	UK	249.97	250.1	P	MON	ES	M	Valley Water

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
07S01W34G002	NA	37.41712	-122.13628	110	90	110	205.46	204.4	P	MON	ES	M	Valley Water
07S01W34G003	NA	37.28096	-121.95610	150	132	147	205.46	204.41	P	MON	ES	M	Valley Water
07S01W34G004	NA	37.28098	-121.95600	300	275	295	205.41	204.37	P	MON	ES	M	Valley Water
07S01W34G005	NA	37.28098	-121.95600	235	210	230	205.41	204.36	P	MON	ES	M	Valley Water
07S01W34G006	NA	37.35924	-121.87557	395	370	390	205.41	204.35	P	MON	ES	M	Valley Water
07S01W35L013	372767N1219439W001	37.27667	-121.94389	530	510	530	218.85	218	P	MON	PT	D	Valley Water
07S01W35L014	372767N1219439W002	37.34725	-121.90705	410	390	410	218.85	217.92	P	MON	PT	D	Valley Water
07S01W35L015	372767N1219439W003	37.34492	-121.87443	300	280	300	218.85	217.97	P	MON	PT	D	Valley Water
07S01W35L016	372767N1219439W004	37.34511	-121.87450	180	160	180	218.85	217.96	P	MON	PT	D	Valley Water
07S01W35L017	372767N1219439W005	37.27667	-121.94389	850	630	650	218.85	217.9	P	MON	PT	D	Valley Water
07S02E06N004	NA	37.34692	-121.79942	516	225	455	205.42	205.99	P	MI	ES	M	Other
07S02E06Q001	NA	37.35079	-121.79624	402	UK	UK	265.5	265	P	MON	ES	M	Valley Water
07S02E07Q003	373346N1217908W001	37.33492	-121.79093	UK	UK	UK	181.94	180.87	UK	MON (was AG)	ES	M	Valley Water
07S02E18B001	NA	37.32966	-121.79411	520	UK	UK	155.73	155.45	P	MON	ES	M	Other
07S02E19B009	373127N1217917W001	37.32871	-121.86814	410	140	400	212.4	212.87	P	MON	ES	M	Valley Water
07S02E19C005	373161N1217973W001	37.32819	-121.86851	1030	740	760	188.81	188.29	P	MON	ES	M	Valley Water
07S02E19C006	373161N1217973W002	37.31606	-121.79734	630	610	630	189.15	188.39	P	MON	ES	M	Valley Water
07S02E19C007	373161N1217973W003	37.32582	-121.86260	390	370	390	189.15	188.4	P	MON	ES	M	Valley Water
07S02E19C008	373161N1217973W004	37.32266	-121.86097	290	270	290	189.15	188.36	P	MON	ES	M	Valley Water
07S02E19C009	373161N1217973W005	37.31606	-121.79735	150	130	150	189.15	188.36	S	MON	PT	D	Valley Water
07S02E21G010	373130N1217564W001	37.31305	-121.75640	358	88	353	494.66	495.26	P	MON	ES	M	Valley Water
07S02E28N003	NA	37.28829	-121.76465	38	UK	UK	435.99	435.99	S	DO	ES	M	Other
07S02W25M001	NA	37.29297	-122.03840	465	UK	UK	326.53	326.38	P	MON	ES	M	Other
08S01E05N002	NA	37.25789	-121.89095	200	UK	UK	184.74	184.17	P	MON	ES	M	Other

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
08S01E07Q003	372471N1219000W001	37.24708	-121.90004	200	UK	UK	228.48	228.12	P	MON	ES	M	Valley Water
08S01E08H004	372522N1218787W001	37.31260	-121.87455	220	UK	UK	187.84	187.44	P	MON	ES	M	Valley Water
08S01E08P003	372447N1218862W001	37.24469	-121.88620	225	UK	UK	213.16	212.56	P	MON	ES	M	Valley Water
08S01E08R001	372457N1218802W001	37.29944	-121.82543	255	18	260	203.35	202.46	P	MON	PT	D	Valley Water
08S01E09N010	NA	37.30139	-121.82653	23	8	23	197.02	196.65	S	MON	ES	M	Valley Water
08S01E10F004	NA	37.30000	-121.82713	69	UK	UK	166.75	166.55	S	MON	ES	M	Other
08S01E10J002	NA	37.30029	-121.82889	191	UK	UK	162.32	162.32	P	MON	PT	D	Other
08S01E11N001	372470N1218400W001	37.24702	-121.83997	177	UK	UK	162.1	161.6	P	MON	ES	M	Valley Water
08S01E15C007	372421N1218495W001	37.24214	-121.84948	435	UK	UK	167.26	167.26	P	MON	PT	D	Valley Water
08S01E25N003	372016N1218171W001	37.20162	-121.81713	90	21	60	346.2	347.95	S	MON	PT	D	Valley Water
08S01E27C002	NA	37.21358	-121.85177	70	UK	UK	274.73	274.11	S	DO	ES	M	Other
08S01W03K013	372624N1219572W001	37.28689	-121.83335	94	UK	UK	249.86	249.69	S	MON	ES	M	Valley Water
08S01W05K004	NA	37.26286	-121.99358	291	UK	UK	323.1	323.31	P	AG	ES	M	Other
08S01W10F002	NA	37.25260	-121.95883	458	98	245	288.06	289.57	P	AG	ES	M	Other
08S02E07A015	NA	37.25617	-121.78760	45	25	45	204.89	204.36	S	MON	ES	M	Other
08S02E16E011	NA	37.23906	-121.76538	350	140	330	226	227	P	MON	ES	M	Valley Water
08S02E16K001	372341N1217571W001	37.23406	-121.75714	223	192	212	235.57	236.9	P	MON	PT	D	Valley Water
08S02E16L004	NA	37.35716	-121.93473	UK	UK	UK	235.68	238.58	P	MON	ES	M	Valley Water
08S02E16L005	NA	37.35641	-121.94058	UK	UK	UK	230	229.5	P	MON	ES	M	Valley Water
08S02E16Q012	NA	37.35286	-121.93721	30	20	30	239.75	242.65	P	MON	ES	M	Valley Water
08S02E16Q013	NA	37.34649	-121.94387	35	25	35	238.75	241.85	P	MON	ES	M	Valley Water
08S02E16Q014	NA	37.35567	-121.95372	35	25	35	239.75	242.6	P	MON	ES	M	Valley Water
08S02E16Q015	NA	37.34614	-121.95892	UK	UK	UK	236.4	239.23	P	MON	ES	M	Valley Water
08S02E16Q016	NA	37.35776	-121.98635	UK	UK	UK	238.33	241.31	P	MON	ES	M	Valley Water
08S02E16Q017	NA	37.35380	-121.98527	UK	UK	UK	238.27	241.1	P	MON	ES	M	Valley Water

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
08S02E16R001	NA	37.34857	-121.98646	280	120	280	239	240	P	MON	ES	M	Valley Water
08S02E18F016	372385N1217981W001	37.34541	-121.97368	179	147	177	193.93	193.58	P	MON	ES	M	Valley Water
08S02E18G010	372396N1217939W001	37.34705	-121.99841	179	138	178	197.56	199.18	P	MON	PT	D	Valley Water
08S02E18L001	372361N1217940W001	37.33226	-122.01863	200	UK	UK	193.53	193.18	P	AG	ES	M	Valley Water
08S02E20F001	NA	37.33203	-122.01842	250	UK	UK	212.96	214.71	P	MI	ES	M	Other
08S02E20F002	NA	37.34180	-121.99194	170	UK	UK	212.77	214.5	P	MI	ES	M	Other
08S02E21A012	NA	37.22983	-121.75228	UK	UK	UK	234.25	237.36	P	MON	ES	M	Valley Water
08S02E22E002	372237N1217459W001	37.22366	-121.74588	110	75	95	240.14	241.78	P	MON	PT	D	Valley Water
08S02E28H002	NA	37.20995	-121.75021	75	UK	UK	245.85	247	P	AG	ES	M	Other
08S02E34A001	NA	37.20073	-121.73283	60	UK	UK	260.95	261.48	P	AG	ES	M	Other
08S02E35G001	NA	37.33402	-122.00073	150	UK	UK	285.85	286.15	P	AG	ST	M	Other
08S02E35M001	NA	37.33954	-121.97379	90	UK	UK	264.2	264.82	P	AG	ST	M	Other
08S02E36M007	371919N1217076W001	37.33730	-121.96920	120	95	110	294.07	296.89	P	MON	PT	D	Valley Water
09S02E01C001	NA	37.33421	-121.98476	165	UK	UK	301.42	301.62	P	DO	ES	M	Other
09S02E01J006	371790N1216958W001	37.33081	-121.98436	165	135	155	315.95	318.69	P	MON	PT	D	Valley Water
09S02E02C001	NA	37.33205	-121.97495	275	UK	UK	269.9	271.03	P	AG	ES	M	Other
09S02E02J002	NA	37.34504	-121.96840	114	UK	UK	290.49	291.92	P	AG	ES	M	Other
09S02E11C001	NA	37.34355	-121.94871	120	UK	UK	286.27	286.82	P	DO	ES	M	Other
09S02E12B001	NA	37.16888	-121.69949	180	UK	UK	314.56	314.96	P	AG	ES	M	Other
09S02E12E001	NA	37.16807	-121.70852	175	UK	UK	299.62	299.72	P	AG	ES	M	Other
09S03E07H003	NA	37.16706	-121.67717	300	UK	UK	347.92	349.19	P	AG	ES	M	Other
09S03E07L002	NA	37.16150	-121.68542	191	UK	UK	332.65	333.05	P	MON	PT	D	Other
09S03E08J016	NA	37.16420	-121.66174	285	UK	UK	370.89	371.19	P	AG	PT	D	Other
09S03E09R004	371583N1216426W001	37.32910	-121.96454	380	350	370	405.57	406.18	P	MON	ES PT	D	Valley Water
09S03E09R005	371583N1216426W002	37.32688	-121.96393	570	445	560	405.57	406.14	P	MON	ES	M	Valley Water
09S03E16F002	371521N1216501W001	37.33014	-121.98956	520	480	500	381.43	381.19	P	MON	PT	D	Valley Water
09S03E17D004	371562N1216707W001	37.30988	-121.96458	232	UK	UK	352.74	353.2	P	MON (was MI)	ES	M	Valley Water

Notes:
Table shows monitoring wells actively monitored by Valley Water as of September 2021. Continued access to wells is not guaranteed, particularly for wells owned by others.
All elevations listed above are reported relative to the North American Vertical Datum of 1988 (NAVD 88).
All horizontal locations listed above are based on the North American Datum of 1983 (NAD 83).
AG = Agricultural well
AM = Airline method
D = Daily
DO = Domestic well
ES = Electric sounder
ft amsl = feet above mean sea level
ft bgs = feet below groundwater surface
M = Monthly
MI = Municipal well
MON = Monitoring well
NA = Value not available
P = Principal aquifer (Note: all wells in Coyote Valley are in the principal aquifer because there is no shallow aquifer designation in Coyote Valley)
PG = Pressure gauge
PT = Pressure transducer
S = Shallow aquifer
ST = Steel tape
UK = Unknown

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Table K-2. Llagas Subbasin Groundwater Level Monitoring Network

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
09S03E15L013	371489N1216307W001	37.29377	-121.92325	200	UK	UK	394.08	394.29	P	DO	ES	M	Valley Water
09S03E16J001	NA	37.14769	-121.64180	400	UK	UK	388.96	389.4	P	AG	ES	M	Other
09S03E20K003	371343N1216641W001	37.13430	-121.66405	100	70	90	354.98	354.78	S	MON	ES	M	Valley Water
09S03E22P005	NA	37.13177	-121.63149	443	UK	UK	360.49	361.16	P	MI	ES	M	Other
09S03E23L005	371357N1216158W001	37.13574	-121.61575	25	10	25	362.81	366	S	MON	PT	D	Valley Water
09S03E23P005	NA	37.13284	-121.61309	49	14	49	356.88	359.88	S	MON	ES	M	Other
09S03E25P001	NA	37.11827	-121.59466	249	UK	UK	356.72	357.93	P	DO	ES	M	Other
09S03E26P001	NA	37.11889	-121.61382	250	UK	UK	331.64	331.99	P	AG	ES	M	Other
09S03E34G002	NA	37.11148	-121.62774	UK	UK	UK	322.2	323.55	UK	AG	ES	M	Other
09S03E35C011	371134N1216134W001	37.11336	-121.61341	91	81	86	324.18	323.51	S	MON	PT	D	Valley Water
09S03E35P013	NA	37.10311	-121.61547	160	80	155	307.18	308.59	P	MI	ES	M	Other
10S03E01N005	370881N1216003W001	37.08806	-121.60031	132	UK	UK	284.12	285.12	S	MON	PT	D	Valley Water
10S03E02N002	NA	37.08705	-121.61570	215	155	215	288.6	289.01	P	DO	ES	M	Other
10S03E03D007	NA	37.09820	-121.63451	220	UK	UK	326.12	326.05	P	DO	ES	M	Other
10S03E11D010	NA	37.08325	-121.61585	181	80	181	281.58	281.97	P	AG	ES	M	Other
10S03E13E006	370670N1216007W001	37.06696	-121.60074	51.5	31.5	51.5	260.76	263.84	S	MON	ES	M	Valley Water
10S03E13E007	NA	37.06829	-121.59772	300	140	300	262.22	263.34	S	MON	ES	M	Valley Water
10S03E13F005	370675N1215949W001	37.06748	-121.59488	54.5	32	52	262.03	265.13	S	MON	PT	D	Valley Water
10S03E13K004	NA	37.06290	-121.58869	199	111	199	254.75	254.75	P	MI	ES	M	Other
10S03E14D001	NA	37.06979	-121.61727	217	UK	UK	277.15	277.5	P	DO	ES	M	Other
10S03E24M001	NA	37.04717	-121.60215	190	UK	UK	237.65	238.05	P	AG	ST	M	Other
10S03E25F001	370357N1215958W001	37.03570	-121.59580	165	125	145	221.98	221.88	S	MON	PT	D	Valley Water
10S04E06P009	NA	37.08693	-121.57731	200	UK	UK	309.3	310.28	P	DO	ES	M	Other
10S04E07E031	NA	37.31606	-121.79735	130	UK	UK	286.84	287.39	S	DO	ES	M	Other
10S04E07F009	NA	37.31606	-121.79734	UK	UK	UK	306.8	307.52	UK	AG	ES	M	Other
10S04E17K002	NA	37.31606	-121.79734	250	UK	UK	299.54	299.54	P	DO	ES	M	Other
10S04E17N002	NA	37.31606	-121.79734	300	UK	UK	258.65	258.75	P	DO	ES	M	Other
10S04E18N007	NA	37.31606	-121.79735	71	UK	UK	249.2	248.45	S	MON	ES	M	Other

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
10S04E20G008	370503N1215519W001	37.05025	-121.55193	90	80	85	242.18	243.18	S	MON	PT	D	Valley Water
10S04E20M001	NA	37.04670	-121.56360	208	UK	UK	222.62	222.92	P	AG	ES	M	Other
10S04E21M002	NA	37.29787	-121.76916	UK	UK	UK	242.65	242.95	UK	AG	ES	M	Other
10S04E28M005	370331N1215434W001	37.35239	-122.03842	60	50	60	210.26	209.93	S	MON	PT	D	Valley Water
10S04E28N006	370316N1215433W001	37.35240	-122.03860	572	532	552	209.75	212.25	P	MON	PT	D	Valley Water
10S04E30Q001	NA	37.35584	-122.03195	120	UK	UK	212.36	212.86	S	DO	ES	M	Other
10S04E32N003	370148N1215633W001	37.35472	-122.02455	UK	UK	UK	198.14	197.86	UK	MON	ES	M	Valley Water
11S04E02D008	NA	37.35045	-122.03472	250	UK	UK	232.94	233.04	P	AG	ES	M	Other
11S04E02N001	NA	37.35132	-122.04874	430	UK	UK	174.91	175.59	P	AG	ES	M	Other
11S04E03G005	370113N1215167W001	37.35651	-122.06156	85	70	80	190.44	192.4	S	MON	PT	D	Valley Water
11S04E03J002	NA	37.35695	-122.07006	415	UK	UK	198.75	199.15	P	DO	ES	M	Other
11S04E04C008	NA	37.35284	-122.06373	250	UK	UK	193.24	194.18	P	DO	ES	M	Other
11S04E04F007	370082N1215405W001	37.34679	-122.07064	55	40	50	194.71	196.78	S	MON	ES	M	Valley Water
11S04E04Q012	370022N1215370W001	37.00216	-121.53699	39	UK	UK	185.22	185.14	S	MON	ES	M	Valley Water
11S04E05F001	370092N1215580W001	37.26266	-121.80623	107	UK	UK	189.56	189.76	S	MI	PT	D	Valley Water
11S04E05H002	370081N1215406W001	37.00812	-121.54064	260	120	260	194.32	197.22	P	MON	ES	M	Valley Water
11S04E07F004	369922N1215757W001	36.99220	-121.57566	200	160	180	211.38	211.29	P	MON	ES	M	Valley Water
11S04E08K002	NA	36.99063	-121.55086	278	53	274	181.84	182.08	P	AG	ES	M	Other
11S04E09J003	369922N1215320W001	36.99221	-121.53204	40	20	40	174.59	174.58	S	MON	ES	M	Valley Water
11S04E10D004	NA	36.99794	-121.52575	370	UK	UK	171.82	172.54	P	AG	ES	M	Other
11S04E10N001	369871N1215282W001	36.98714	-121.52824	550	510	530	167.48	167.17	P	MON	PT	D	Valley Water
11S04E15J002	NA	37.25099	-121.84932	UK	UK	UK	145.04	147.69	UK	AG	ST	M	Other
11S04E15J003	369767N1215123W001	36.97667	-121.51233	53	48	53	153.56	153.26	S	MON	PT	D	Valley Water
11S04E17N004	NA	36.97375	-121.56186	80	UK	UK	183.55	184.82	S	AG	ES	M	Other
11S04E21G003	369654N1215318W001	37.25823	-121.81933	85	70	80	168.31	169.66	S	MON	PT	D	Valley Water
11S04E21P003	NA	37.24745	-121.81308	UK	UK	UK	156.71	157.79	UK	AG	ES	M	Other
11S04E22N001	NA	37.24109	-121.81425	220	UK	UK	154.05	154.41	P	AG	ES	M	Other

Well Number	CASGEM WELL ID	Latitude	Longitude	Well Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Method	Frequency	Well Owner
11S04E28K001	369486N1215359W001	37.23880	-121.80409	335	295	315	138.4	141.6	P	MON	PT	D	Valley Water
11S04E28K002	369483N1215360W001	36.94832	-121.53595	100	85	95	138.45	140.95	S	MON	ES	M	Valley Water
11S04E32R002	369296N1215465W001	37.22797	-121.86740	170	UK	UK	144.61	145.11	P	AG	ES	M	Valley Water

Notes:
Table shows monitoring wells actively monitored by Valley Water as of September 2021. Continued access to wells is not guaranteed, particularly for wells owned by others.
All elevations listed above are reported relative to the North American Vertical Datum of 1988 (NAVD 88).
All horizontal locations listed above are based on the North American Datum of 1983 (NAD 83).
AG = Agricultural well
AM = Airline method
D = Daily
DO = Domestic well
ES = Electric sounder
ft amsl = feet above mean sea level
ft bgs = feet below groundwater surface
M = Monthly
MI = Municipal well
MON = Monitoring well
NA = Value not available
P = Principal aquifer
PG = Pressure gauge
PT = Pressure transducer
S = Shallow aquifer
ST = Steel tape
UK = Unknown

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Table K-3. Santa Clara Subbasin Groundwater Quality Monitoring Network

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
05S03W36P005	37.45024	-122.14299	200	180	200	24.42	23.59	P	MON	Annual	Valley Water
06S01W01M001	37.43819	-121.92840	265	255	265	22.86	24.97	P	MON (was AG)	Annual	Valley Water
06S01W02N008	37.43439	-121.94788	35	10	15	9.75	9.75	S	MON	Annual	Valley Water
06S01W10N007	37.41831	-121.96857	82.5	73	78	12.6	12.73	S	MON	Annual	Valley Water
06S01W12G005	37.42634	-121.92452	37	30	35	16.75	16.75	S	MON	Annual	Valley Water
06S01W13C009	37.26191	-121.80074	51	40	46	36.29	36.12	S	MON	Annual	Valley Water
06S01W14L005	37.25905	-121.79006	47	37	42	17.75	17.75	S	MON	Annual	Valley Water
06S01W15R006	37.25754	-121.78947	57	45	51	15.75	15.75	S	MON	Annual	Valley Water
06S01W17F002	37.25833	-121.78977	210	190	200	2.47	2.24	P	MON	Annual	Valley Water
06S01W17M009	37.40997	-122.00554	45	20	45	12.75	12.75	S	MON	Annual	Valley Water
06S01W18R007	37.24959	-121.78566	45	20	45	12.75	12.75	S	MON	Annual	Valley Water
06S01W22K010	37.24705	-121.77325	100	60	65	25.75	25.75	S	MON	Annual	Valley Water
06S01W24H015	37.25075	-121.78060	227	UK	UK	42.75	42.3	P	MON (was AG)	Annual	Valley Water
06S01W24J037	37.23906	-121.76538	65	56	61	46.13	45.8	S	MON	Annual	Valley Water
06S01W24P007	37.39027	-121.92647	96	81	86	29.75	29.75	S	MON	Annual	Valley Water
06S01W26K001	37.38043	-121.93854	65	55	60	35.81	34.9	S	MON	Annual	Valley Water
06S01W26N006	37.23438	-121.76072	100	77	82	42.75	42.75	S	MON	Annual	Valley Water
06S01W26R004	37.23275	-121.76303	330	310	330	31.36	32.66	P	MON	Annual	Valley Water
06S02W05F002	37.23290	-121.75563	50	40	50	6.76	8.36	S	MON	Annual	Valley Water
06S02W05F003	37.23320	-121.75551	200	190	200	6.76	8.76	P	MON	Annual	Valley Water

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
06S02W07B023	37.23384	-121.75615	45	28	45	14.49	13.34	S	MON	Annual	Valley Water
06S02W16L021	37.40688	-122.08863	40	20	40	38.08	37.65	S	MON	Annual	Valley Water
06S02W17L003	37.40953	-122.10973	122	UK	UK	40	40	S	DO	Annual	Other
06S02W24C008	37.40137	-122.03546	250	UK	UK	32.33	34.83	P	MON	Annual	Valley Water
06S02W24J009	37.23129	-121.75317	55	30	50.5	34.55	34.15	S	MON	Annual	Other
06S02W34J001	37.23909	-121.77566	140	120	130	169.2	169	S	MON	Annual	Valley Water
06S03W01B010	37.23604	-121.76918	101	93.5	98.5	20.25	19.23	S	MON	Annual	Valley Water
07S01E09L007	37.24134	-121.80082	425	405	425	86.94	88.09	P	MON	Annual	Valley Water
07S01E09L008	37.23940	-121.79922	72	62	72	87.07	87.97	S	MON	Annual	Valley Water
07S01E19B002	37.23834	-121.80207	85	75	85	114.85	114.69	S	MON	Annual	Valley Water
07S01E19B006	37.31611	-121.90325	240	220	240	114.85	115.05	P	MON	Annual	Valley Water
07S01E24P001	37.23956	-121.79387	277	164	272	164.03	162.48	P	MON	Annual	Valley Water
07S01E35E003	37.27977	-121.83600	148	46	146	167.84	166.92	S	MON	Annual	Other
07S01W14P002	37.23641	-121.79384	440	420	440	141.46	141.03	P	MON	Annual	Valley Water
07S01W14P005	37.31774	-121.94346	150	130	150	141.46	141.06	S	MON	Annual	Valley Water
07S01W29C005	37.30077	-121.99754	380	360	380	231.12	231.92	P	MON	Annual	Valley Water
07S01W35L015	37.27667	-121.94389	300	280	300	218.85	217.97	P	MON	Annual	Valley Water
07S01W35L016	37.27668	-121.94389	180	160	180	218.85	217.96	P	MON	Annual	Valley Water
07S02E19C007	37.31606	-121.79734	390	370	390	189.15	188.4	P	MON	Annual	Valley Water
07S02E19C009	37.20726	-121.73029	150	130	150	189.15	188.36	S	MON	Annual	Valley Water
08S01E21B001	37.20979	-121.73287	80	40	80	220	220	S	MI	Annual	Other
08S01E25N003	37.20851	-121.73161	90	21	60	346.2	347.95	S	MI	Annual	Valley Water
08S01W10F002	37.20995	-121.75021	458	98	245	288.06	289.57	P	AG	Annual	Other

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
08S02E16K001	37.23406	-121.75714	223	192	212	235.57	236.9	P	MON	Annual	Valley Water
08S02E18G009	37.19826	-121.72120	111	80	110	200	200	S	MON	Annual	Other
08S02E18G010	37.19821	-121.72109	179	138	178	197.56	199.18	P	MON	Annual	Valley Water
08S02E22E002	37.19619	-121.71970	110	75	95	240.14	241.78	P	MON	Annual	Valley Water
08S02E36M007	37.19443	-121.71625	120	95	110	294.07	296.89	P	MON	Annual	Valley Water
09S02E01J006	37.17897	-121.69576	165	135	155	315.95	318.69	P	MON	Annual	Valley Water
09S03E07J003	37.18731	-121.72384	230	130	230	346.75	346.75	P	DO	Annual	Other
09S03E09R004	37.15833	-121.64262	380	350	370	405.57	406.18	P	MON	Annual	Valley Water
09S03E17B005	37.15677	-121.66252	275	125	139	370	370	P	DO	Annual	Other

Notes:

Table shows monitoring wells actively monitored by Valley Water as of September 2021. Continued access to wells is not guaranteed, particularly for wells owned by others.
All elevations listed above are reported relative to the North American Vertical Datum of 1988 (NAVD 88).
All horizontal locations listed above are based on the North American Datum of 1983 (NAD 83).
AG = Agricultural well
DO = Domestic well
ft amsl = feet above mean sea level
ft bgs = feet below groundwater surface
MI = Municipal well
MON = Monitoring well
NA = Value not available
P = Principal aquifer
S = Shallow aquifer

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Table K-4. Llagas Subbasin Groundwater Quality Monitoring Network

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
09S03E15K009	37.14494	-121.62218	250	150	250	384	384	P	DO	Annual	Other
09S03E20K003	37.13430	-121.66405	100	70	90	354.98	354.78	S	MON	Annual	Valley Water
09S03E21C003	37.14271	-121.64779	200	100	200	374.75	374.75	P	DO	Annual	Other
09S03E34P001	37.10426	-121.63142	163	103	163	320.75	320.75	P	DO/MI	Annual	Other
09S03E35C012	37.11340	-121.61344	61	45	55	325.75	325.75	S	MON	Annual	Valley Water
09S03E36B007	37.11519	-121.59327	225	165	225	350	350	P	DO	Annual	Other
10S03E01A009	37.09957	-121.58521	300	UK	UK	316.75	316.75	P	DO	Annual	Other
10S03E02N002	37.08705	-121.61570	215	155	215	288.6	289.01	P	DO	Annual	Other
10S03E03D007	37.16244	-121.67933	220	UK	UK	326.12	326.05	P	DO	Annual	Other
10S03E12P003	37.07284	-121.59489	182	100	182	265.95	264.95	P	DO	Annual	Other
10S03E13F005	37.06748	-121.59488	54.5	32	52	262.03	265.13	S	MON	Annual	Valley Water
10S03E14P005	37.16706	-121.65304	198	140	198	264.95	264.95	P	DO	Annual	Other
10S03E25F001	37.16686	-121.65311	165	125	145	221.98	221.88	P	MON	Annual	Valley Water
10S03E36H001	37.16818	-121.65032	440	220	260	209	209	P	MON	Annual	Other
10S03E36H004	37.16465	-121.65481	440	60	90	209	209	S	MON	Annual	Other
10S04E07E031	37.08216	-121.58265	130	UK	UK	286.84	287.39	P	DO	Annual	Other
10S04E07E033	37.08081	-121.58166	228	180	228	285	285	P	DO	Annual	Other
10S04E17K002	37.14494	-121.62218	250	UK	UK	299.54	299.54	P	DO	Annual	Other
10S04E19K006	37.04747	-121.57256	295	175	295	232.75	232.75	P	DO	Annual	Other
10S04E20G008	37.05025	-121.55193	90	80	85	242.18	243.18	S	MON	Annual	Valley Water
10S04E28M005	37.03313	-121.54338	60	50	60	210.26	209.93	S	MON	Annual	Valley Water
10S04E32E006	37.15677	-121.66252	285	225	280	206	206	P	MON	Annual	Other
11S03E01Q002	37.00036	-121.58945	44	29	44	216.59	216.38	S	MON	Annual	Valley Water
11S03E02E001	37.00977	-121.61935	100	60	100	240	240	S	DO	Annual	Other
11S04E03G005	37.14271	-121.64779	85	70	80	190.44	192.4	S	MON	Annual	Valley Water
11S04E04F007	37.13932	-121.65293	55	40	50	194.71	196.78	S	MON	Annual	Valley Water
11S04E05F001	37.13558	-121.64748	107	UK	UK	189.56	189.76	S	MON (was AG)	Annual	Valley Water
11S04E05H002	37.13536	-121.64744	260	120	260	194.32	197.22	P	MON (was AG)	Annual	Valley Water
11S04E08K002	37.13153	-121.64413	278	53	274	181.84	182.08	P	AG/DO	Annual	Other
11S04E08K008	37.13690	-121.63596	103	48	98	185	185	S	MON	Annual	Other
11S04E10L017	37.14054	-121.63140	150	50	150	160	160	P	DO	Annual	Other
11S04E11J007	37.13393	-121.62833	230	120	220	160	160	P	DO	Annual	Other
11S04E15P003	37.13221	-121.63099	248	161	242	150	150	P	DO	Annual	Other
11S04E17N004	36.97375	-121.56186	80	UK	UK	183.55	184.82	S	DO	Annual	Other
11S04E21J003	37.13222	-121.63105	200	160	200	160	160	P	DO	Annual	Other

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
11S04E28K001	37.13869	-121.61410	335	295	315	138.4	141.6	P	MON	Annual	Valley Water
11S04E28K002	36.94832	-121.53595	100	85	95	138.45	140.95	S	MON	Annual	Valley Water

Notes:
Table shows monitoring wells actively monitored by Valley Water as of September 2021. Continued access to wells is not guaranteed, particularly for wells owned by others.
All elevations listed above are reported relative to the North American Vertical Datum of 1988 (NAVD 88).
All horizontal locations listed above are based on the North American Datum of 1983 (NAD 83).
AG = Agricultural well
DO = Domestic well
ft amsl = feet above mean sea level
ft bgs = feet below groundwater surface
MI = Municipal well
MON = Monitoring well
NA = Value not available
P = Principal aquifer
S = Shallow aquifer

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Table K-5. Llagas Subbasin Recycled Water Monitoring Network

Well Number	Latitude	Longitude	Depth (ft bgs)	Top of First Screen (ft bgs)	Bottom of Last Screen (ft bgs)	Ground Surface Elevation (ft amsl)	Measuring Point Elevation (ft amsl)	Aquifer	Well Type	Frequency	Owner
11S03E01E003	37.00680	-121.60083	100	UK	UK	224.45	223.99	S	MON	Semi-annually	Valley Water
11S03E01E004	37.00731	-121.60063	43	UK	UK	225.61	225.31	S	MON	Semi-annually	Valley Water
11S03E01E005	37.00683	-121.60086	43	UK	UK	224.68	227.23	S	MON	Semi-annually	Valley Water
11S03E01Q002	37.12804	-121.62840	44	29	44	216.59	216.38	S	MON	Semi-annually	Valley Water
11S03E02H004	37.12722	-121.64789	43	UK	UK	226.19	225.99	S	MON	Semi-annually	Valley Water
11S03E12A002	37.11512	-121.63633	45	30	45	210.63	210.22	S	MON	Semi-annually	Valley Water
11S03E12A003	36.99707	-121.58434	45	30	45	211.84	211.4	S	MON	Semi-annually	Valley Water
11S04E07F004	37.10426	-121.63142	200	160	180	211.38	211.29	P	MON	Semi-annually	Valley Water
11S04E07J005	36.98928	-121.56498	55	UK	UK	197.51	196.92	S	MON	Semi-annually	Valley Water
11S04E08C003	37.11340	-121.61344	38	UK	UK	188.97	189.04	S	MON	Semi-annually	Valley Water
11S04E08D006	36.99582	-121.56037	34	UK	UK	190.39	190.03	S	MON	Semi-annually	Valley Water
11S04E08M013	37.11519	-121.59327	54	UK	UK	194.38	193.97	S	MON	Semi-annually	Valley Water
11S04E08M015	37.09957	-121.58521	80	UK	UK	194.3	194.2	S	MON	Semi-annually	Valley Water
11S04E08N009	36.98691	-121.56419	60	UK	UK	193.36	192.76	S	MON	Semi-annually	Valley Water
11S04E09D002	36.99670	-121.54648	38	UK	UK	178.01	177.82	S	MON	Semi-annually	Valley Water
11S04E09M001	36.99127	-121.54399	40	UK	UK	175.17	175.36	S	MON	Semi-annually	Valley Water
11S04E15M002	36.97519	-121.52860	40	10	30	155.75	158.9	S	MON	Semi-annually	Other
11S04E16F001	37.07284	-121.59489	40	UK	UK	172.12	174.27	S	MON	Semi-annually	Other
11S04E16G003	36.98223	-121.52833	120	100	110	159.4	161.65	S	MON	Semi-annually	Other
11S04E16M011	36.97659	-121.54347	47	UK	UK	175.85	178.43	S	MON	Semi-annually	Other

Notes:
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All horizontal locations listed above are based on the North American Datum of 1983 (NAD 83).
AG = Agricultural well
ft amsl = feet above mean sea level
ft bgs = feet below groundwater surface
MON = Monitoring well
NA = Not available
P = Principal aquifer
S = Shallow aquifer

Valley Water

Santa Clara Valley Water District
5750 Almaden Expressway, San Jose, CA 95118-3686
Phone: (408) 265-2600 Fax: (408) 266-0271
www.valleywater.org

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